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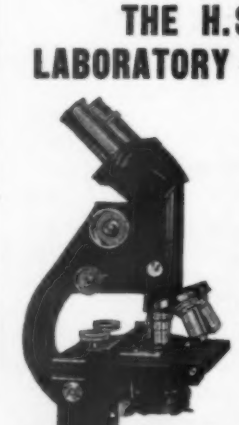

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Vol. 142 SATURDAY, SEPTEMBER 3, 1938 No. 3592

Co-operation between the British and American Associations

IT is probable that Lord Rayleigh's term of office will mark one of the most momentous periods in the long history of the British Association. To take the initiative in forming a Division to deal with the social and international relations of science is to undertake an onerous and responsible task for which the Association is peculiarly fitted, and in which it will have the good wishes of all who realize the effect that advances in science may have, for good or ill, on the welfare of our own community and of the nations of the world at large. As the Council of the Association does not meet until November, the General Committee, at its final meeting at Cambridge, approved the appointment of a provisional committee, and a few possible members of this committee were suggested to be invited to serve upon it. The publication of a list of the names of these members as forming even a provisional committee is, however, premature and unauthorized.

The Cambridge meeting has been signalized by yet another advance of international importance. The American Association for the Advancement of Science has aims and interests which have much in common with those of the British Association, and it has long been felt that a closer liaison between the two Associations would hasten the realization of those ideals of international co-operation and good will, and would form a very considerable contribution made by men of science to the cause of world peace.

By a happy chance, the principal officers of the American Association were able to be present at the Cambridge meeting of the British Association, and they have agreed to transmit to their executive two suggestions, which have the full approval of the General Committee of the British Association, for promoting a closer union between the two Associations. It is suggested that, in alternate years, a distinguished American man of science should be invited to deliver an address before the members of the British Association at their annual meeting, and reciprocally, in the years not marked by such lectures, that a distinguished British scientific worker should address the members of the American Association at their summer meeting.

These addresses, which will be devoted to a topic of broad scientific interest, will usually, but not necessarily, deal with some of those aspects of science and society which are the concern of the new Division of the British Association.

Further, the officers of the Associations are anxious that the Associations, through their members, should have more intimate knowledge, each of the other's work. As a beginning to that end, it is suggested that a number of those actively engaged in the work of either Association, as members of Council or otherwise, should be elected to membership of the sister Association, with the full privileges of attendance at meetings and of reception of journals.

This principle of exchange of the privileges of membership may be greatly extended in the future; but, in this connexion much will depend on the form taken by the new quarterly journal which will replace the present annual report of the British Association after the publication of the report of the Cambridge meeting.

The Associations are to be warmly congratulated on their courage and initiative in taking these steps, steps which are obviously but the beginnings of others which will lead to greater understanding and closer co-operation, with corresponding repercussions on the friendship between two great democratic communities.

Business Research

"That which man altereth not for the better,
Time, the great Innovator, altereth for the worse."
FRANCIS BACON.

TO-DAY we are almost all of us forced to think in terms of progress, although there are still some who find no interest in the idea of change and think rather of conserving the ancient values. Human wants are increasing both in variety and in intensity. On all sides and in all countries the standard of living is advancing rapidly. The word living no longer implies food and warmth and shelter only, but includes much in the way of recreation and amusement.

The present world-wide state of unrest is an expression of the need for adjustment to change, partly arising from the effect of scientific discovery upon the whole framework of economics, politics and sociology. Adaptation to new conditions always requires increased effort and has to overcome indifferent and vested interests, political and academic, just as change in industry is resisted by financial interests. Whatever the attitude may be to the process, it must be admitted that we are in the presence of constant and relatively rapid change. The outstanding problem in business of all kinds is that of peaks and depressions; the ups and downs of the curve of prosperity become apparently more pronounced and more frequent. Planning has failed to flatten the curve; business sentiment and action are all one way at any particular moment, and the short view prevails.

The consequences, both social and political, are very disturbing. It has been suggested that commerce, or those engaged in it, is insufficiently educated in science to be able to grasp the potentialities of the application of scientific method to industry. These changes have been brought about by engineering science almost everywhere, except in commerce as distinct from industry. An example is the recent sharp rise and fall in base metals. An apparent shortage encouraged a rush to buy forward and some speculation. The price increase brought largely increased supplies into sight through technical activity; the buying became unnecessary and ceased; the speculators threw their holdings on a market bare of buyers, and a serious slump followed.

Improvement means research, and it is indicative of the new trend that the chairman of company after company announces that organized research has become the dominant competitive weapon for their particular establishments. The research is not always or necessarily scientific, but that is partly because the word science is used to indicate the applied natural sciences. What is wanted by business men is a wider training in scientific method, which perhaps can best be gained through natural science. The ability to weigh evidence is the faculty of the legal profession, which makes use of it to sway judge or jury. In science it is Nature which has to be interpreted, and every observation should be followed to a logical end; theories should act merely as working hypotheses: the greatest investigator is he who can devise an experiment to test a principle and can carry it out.

In business the demands are more complex; yet the business man should at least have scientific method as the foundation of his knowledge and not regulate his activities by a series of shots which are described in city language as 'market anticipation'.

Research in industry has been defined as the development of a new idea from its genesis until the time when it meets the approval of the consumer. A progressive company has to be ready to introduce the new product, the new design, the new formula, with as great facility as it introduces new raw materials or new machines. As the Americans say, the rate at which older markets wane establishes the rate at which newer markets must be developed. This is an important principle which is not always understood; firms have been known to overdo the issue of new lines to the confusion of their customers and the detriment of their trade.

The gas industry affords an interesting example of the recognition of the need of business research in catering for its customers; we make use here of Sir David Milne-Watson's address to the International Engineering Congress at Glasgow. Gas-fires made their appearance on the market about 1853, when an early technician remarked "to meet the wishes of that unreasoning portion of the community which liked its source of heat to be bright, two classes of stove have been designed, viz., the cheerful stoves and the class known as

gas-fires". Much later, when electrical competition became a serious threat, modernization of appliances and of its whole contact with the public became an urgent task for the gas industry. Research was strengthened with the view not only to efficiency but also to appearance. In five years the new armament of the industry was forged, the enamelled gas cooker, the modern coke fire, thermostatic control, water-heaters, stream-lined coloured gas-fires, refrigerators, all became available for the public with an efficiency of twenty per cent greater than before. No wonder the industry strengthened its grip on the market and is casting around for wider fields of development.

In these days of quick change, it is not surprising that the relation of industry to the State should come under consideration and that there are some who would displace industry as it is now constituted by some form of national effort. On the other hand, Prof. E. H. Schell, of Massachusetts, recently expressed the view that industry will continue in the main to evolve along the present lines whatever developments may take place in the social structure. The future policy of industry must be one of continuity, although it must be even more flexible to change. Such change must not be emotional and hasty, but studied and calculated, the result of what has been sought to describe here as business research.

Flame

Combustion, Flames and Explosions of Gases By Dr. Bernard Lewis and Dr. Guenther von Elbe. (The Cambridge Series of Physical Chemistry.) Pp. xiv + 415. (Cambridge: At the University Press, 1938.) 21*s.* net.

ELEVEN years ago appeared the comprehensive monograph entitled "Flame and Combustion in Gases" by Prof. W. A. Bone and D. T. A. Townend, followed a year or two later by "Gaseous Combustion at High Pressures" by Bone, Newitt and Townend. Except for a small volume on "Flame" by O. C. de C. Ellis and W. A. Kirkby (1936), the subject has not since been treated as a whole in English, until the recent appearance of the work by Bernard Lewis and G. von Elbe now under review.

The new book deals almost entirely with developments in the last eleven years, and admirably supplements Bone's books. It covers a period in which the ruling idea among many of those who have studied the chemistry of combustion is that of chain reactions, for the year after the publication of Bone and Townend's book saw the appearance in the *Zeitschrift für Physik* of Semenoff's paper on the "Theory of the Mechanism of Combustion".

The authors accept the view that chain reactions are characteristic of most processes of gaseous combustion, although "the question has to be decided in every individual case from the sum total of experimental data. Sometimes there are compelling criteria, such as a large quantum yield in the photochemical reaction or the phenomenon of the upper explosion limit" (that is, the experimental fact that many gaseous mixtures can be maintained at a suitable temperature and pressure without undergoing more than very slow chemical change, but inflame at the same temperature when the pressure is reduced to a well-defined value). "In other cases it is difficult to demonstrate more than the great possibility of the chain mechanism because it is difficult to eliminate positively all other alternatives". The main criticism that has been made against the somewhat facile explanation of combustion reactions by a chain mechanism is that the postulated chain carriers have rarely been isolated from, or detected in, the reacting mixtures. Moreover, it seems that each student of any one reaction postulates a different scheme for the sequence of events of his chain reaction.

The idea of a chain reaction in combustion processes has historical authority, for H. B. Dixon's interpretation of the catalytic effect of small amounts of water vapour on the inflammation of carbon monoxide was a chain mechanism; carbon monoxide was oxidized by water vapour, hydrogen being set free and in turn oxidized by molecular oxygen to re-form the catalyst. Much further back, Mrs. Fulhame in her remarkable "Essay on Combustion" (1794), writing of the reduction of metallic oxides by carbon, says, "water is essential to the reduction of metals in low degrees of heat—since the water is instantly decomposed by the charcoal, it is a necessary consequence, that its carbone must unite with the oxygen of the water, while the hydrogen of the latter unites, in its nascent state, with the oxygen of the metal, and reduces it, forming a new quantity of water equal to that decomposed: this new quantity of water may be decomposed in its turn: so that a thimble

full of water would be sufficient to reduce any quantity of metal; provided the water were prevented from escaping, and time enough allowed".

The authors' own attempts to postulate a chain mechanism capable of explaining both the slow and the explosive combustion of hydrogen with oxygen have appeared in print hitherto in part only. They now present the whole picture in some forty pages of concise exposition which covers most of the experimental results of the many workers on the subject. Whether it is a true view of what happens may be questionable, but the summary alone is valuable. By somewhat similar schemes they describe the combustion of carbon monoxide and, more hypothetically and still more elaborately, the combustion of hydrocarbons.

Following this lengthy, but not too long, treatment of the chemistry of combustion, there are brief chapters on emission spectra and ionization in the flame front (6 pages), on ignition by sparks (11 pages) and on limits of self-propagation of flame (5 pages). Photographic methods of recording flame movements are next described briefly, with a mathematical analysis of the mechanism of combustion when an explosive mixture is ignited at the centre of a closed spherical container; by the application of this analysis, the speeds of flame in a stationary gas mixture, over a range of pressures, have been deduced from explosion records of oxygen-ozone mixtures.

The authors describe as "burning velocity" of a gas mixture what previous writers have variously called "vitesse normale", "entzündungsgeschwindigkeit", and "fundamental speed" of flame, that is, the linear speed of flame, in a direction normal to its surface, through a mixture at rest and at constant temperature and pressure just ahead of the flame. They describe various methods of determination of this constant, the analysis of which is perhaps the outstanding unsolved problem in the subject of flame propagation.

Chapters on detonation (33 pages) and on thermodynamic functions of gases deduced from band spectroscopy (15 pages) leading to the calculation of explosion pressures, temperatures and flame volumes (64 pages) are welcome summaries of mathematical and experimental work on difficult subjects.

A short discussion of problems in technical combustion processes (29 pages) is confined almost entirely to those of internal combustion engines, perhaps because the most interesting theoretical problem in technical combustion processes is that of 'knock' in these engines.

Some useful appendixes contain tabulated data on the energy contents of gases up to flame temperatures, equilibrium constants of various reactions in flames, heats of combustion and of other flame reactions, limits of inflammability, and flame temperatures.

The book appeals to the reviewer as, on the whole, a well-balanced account of modern work on flame. If, not unnaturally, it may seem to give relatively somewhat great attention to American work, most readers will nevertheless be grateful for the concise way in which the more intricate parts of the subject are expounded and co-ordinated.

H. F. COWARD.

Organisms and the Earth

The Origin of Life:

By A. I. Oparin. Translation, with Annotations, by Prof. Sergius Morgulis. Pp. x+270. (New York: The Macmillan Company, 1938.) 8*s*. 6*d*. net.

THIS book falls into three distinct parts: the history of ideas on the origin of life, geochemistry, and the author's picture of a possible mode of development of organisms. The historical part is reasonably complete and is suitably garnished with quotations from Engels, but it is spoilt by occasional lapses of which it is very unlikely that Engels or his immediate followers would have been guilty. A reader of the book will realize that the following sentence is no more ridiculous when taken out of its context than it was when in it. "No matter how minute the ultra-microbes are, if they are living organisms they must be endowed with a definite and complex organisation which makes it possible for them to perform a number of vital functions".

In the section on geochemistry a picture is presented of the composition of the earth's surface layer when there was nothing on it that could conceivably be described as living. We have long been accustomed to the idea that the earliest forms of life were strictly anærobic and that atmospheric oxygen is a biological product made chiefly by the green plants. Oparin carries these ideas a stage further and maintains that the primitive atmosphere contained neither carbon dioxide nor nitrogen, and that carbon was present on the surface of the earth either in the elementary form or as hydrocarbons. The well-known fact that volcanic gases contain carbon dioxide is

interpreted as a present-day phenomenon due to the descent of carbonate containing metamorphic rocks into the earth's interior.

The third section will probably be found the least satisfactory by those readers who do not feel that any hypothesis is preferable to a suspension of judgment. In it the chemical and colloid chemical processes which might be expected to take place in an environment consisting largely of hydrogen, water, ammonia, hydrogen sulphide and an extensive range of hydrocarbons, are discussed. In this discussion, plausible mechanisms are put forward for the origin of relatively complex molecules similar to those now found in biological material. The resulting pabulum will naturally accumulate century by century until in parts its complexity becomes sufficient for colloidal phenomena to play a part, and it is in a system of partially miscible liquids that the 'origin of life' is envisaged. It is possible that Oparin has taken rather too seriously Hopkins's epigrammatic description of the cell as a "dynamic equilibrium in a polyphasic system".

The most important idea put forward in this book is the heterotrophic character of primitive living forms. It is argued that the autotrophic organisms developed from these primitive heterotrophic forms when the latter had used up so much of the available complex material that a new mode of metabolism began to have 'survival value'. The process would then continue in the manner generally assumed with the formation of free oxygen by the photosynthetic autotrophes, and lead finally to the evolution of oxygen-using organisms.

The book is stimulating, instructive and, so far as the reviewer is competent to judge, reasonably accurate over matters of fact. The title-page would have been more descriptive of the contents if it had included as a sub-title "Dr. Oparin's answers to a scientific general knowledge paper".

N. W. P.

Symbolic Logic and the Philosophy of Science

(1) An Introduction to Symbolic Logic
By Sussanne K. Langer. Pp. 363. (London: George Allen and Unwin, Ltd., 1937.) 12*s*. 6*d*. net.

(2) Grundzüge der theoretischen Logik
Von Prof. D. Hilbert und W. Ackermann. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen mit besonderer Berücksichtigung der Anwendungsgebiete, Band 27). Zweite verbesserte Auflage. Pp. viii+134. (Berlin: Julius Springer, 1938.) 10.80 gold marks.

(3) An Introduction to the Philosophy of Science
By Prof. A. Cornelius Benjamin. Pp. xvi+469. (New York: The Macmillan Co., 1937.) 16*s*. net.

(4) Die Bedeutung der Modernen Physik für die Theorie der Erkenntnis
Von Dr. Grete Hermann, Dr. E. May, und Dr. Th. Vogel. Pp. viii+210. (Leipzig: S. Hirzel, 1937.) 6.50 gold marks.

(1) A KNOWLEDGE of the techniques of symbolic logic is now almost essential for an appreciation of modern philosophical thought, with its increasing dependence upon purely formal studies such as mathematical logic, semantics and the like. This introduction to the subject by the tutor in philosophy in Radcliffe College, which, as the author justly claims, is the first of its kind, is therefore particularly welcome; especially as it is designed for students, who are often puzzled by the seeming unrelatedness of the different branches of the subject and by the varying terminologies used.

The book is planned to show the connexions between the different branches of the subject, and is built around the two great achievements in symbolic logic—that masterpiece in logistics represented by the "Principia Mathematica" of Whitehead and Russell, and the Boole-Schroeder algebra. It is both a text-book with numerous exercises to train the student in the manipulation of symbols, and an essay on these forms of logic.

Thus, anyone who masters the material provided in the book will be well equipped to pursue the subject further for himself in one or more of the special branches. Furthermore, since the author lays special emphasis upon the principles of logical construction, the possibilities and limits of formalization, the fundamental types of formulæ and the difference between fertile and sterile ideas, the student should also be in a position to understand the epistemological problems which arise in the contemporary philosophy of science.

(2) The main structure of Hilbert and Ackermann's work on 'theoretical' logic has been retained in the second edition, which appears now after an interval of ten years. In the meantime, the first volume of a comprehensive work in which Hilbert and his other collaborator, Bernays, have

applied the logical calculus in an attempt to achieve non-contradiction in the foundations of mathematics, has been published.

The principal alterations and improvements in the present edition of the work under review, which are consequent upon advances made in the subject during the past few years, begin in the third chapter. Here, the rules of derivation for the functional calculus, which were not formulated with sufficient precision in the earlier edition, are re-stated. Further, since an exposition of the so-called 'branched' theory of types of Whitehead and Russell seemed no longer necessary, in view of the fact that it has become almost universally abandoned to-day, Chapter iv has been considerably shortened. On the other hand, the section dealing with the construction of the calculus of predicates of the second type and of the calculus of types itself, has been both improved and rounded-off. The terminology of the whole treatise has been altered to conform to that of the larger work of Hilbert and Bernays. Thus, for example, the expression 'functional calculus' has been replaced everywhere by 'calculus of predicates', and in accordance with current logistical terminology, the terms 'logical sum' and 'logical product' changed to 'conjunction' and 'disjunction' respectively.

(3) In this ample philosophical treatise, which is modestly termed an 'introduction' to a new discipline that is alternatively called philosophy of science, logic of science, science of science and metaphysics of science, Prof. Benjamin divides his subject-matter, or problems, into three sections. He considers the task of the philosophy of science to be, in the first place, the ascertainment of the limits of the special sciences, of their integrations with one another and of their implications in so far as these contribute to a theory of the universe or to some pervasive part of it. Examination of the method of science constitutes the second part of the task; and a clarification of the basic concepts and postulates of science to reveal the fundamental empirical grounds (or absence of grounds) on which they rest, the third.

Thus, in Part 1 of the treatise, Prof. Benjamin examines such problems as logical structure, the nature of symbols, perception, descriptive techniques, descriptive science and the theories of concepts represented by empiricism, operationalism, constructionalism, logical positivism and so on. In Part 2 he deals with problems in the analysis of the concepts of science—number, quantity, space, time, motion, etc.; and finally, in Part 3, he discusses such speculative problems as human freedom and the nature of reality. He emphasizes the necessity of recognizing that the latter are dependent upon the more critical problems, and considers it fortunate that in recent years the attention of investigators has been directed principally to problems of formal logic and to those of the foundations and inter-relations of the sciences. He further points out, that the distinction between a general textbook of the philosophy of science of this kind and an introduction to philosophy by way of the sciences, lies in the fact that the latter pays more attention to the subject-matter than does this book, which attempts to acquaint the student with the foundations rather than with the facts of science.

(4) In awarding the Richard Avenarius Prize of 1936 jointly to the authors of these three essays on the significance of the quantum and field theories of modern physics for the theory of knowledge, the Saxon Academy of Science was influenced by fertility and originality in the ideas expressed rather than by unanimity in the conclusions. Nevertheless, although the treatment of the subject is different in each case, there is great similarity in the conclusions.

In the first essay, Dr. Grete Hermann, of Bremen, examines all the epistemological implications of the results achieved in modern quantum mechanics and field theories, and comes to the conclusion that the only rejection required by the new theories as distinguished from classical physics and mechanics is the claim to absoluteness. Further, that the whole investigation of Nature from the point of view of the new theories is characterized by the renunciation of a perceptual model of any adequacy.

The second thesis, by Dr. May, of Göttingen, is the longest of the three, and is richer in historical and philosophical detail as well as in criticism of contemporary tendencies—logical positivism, etc.—than either of the others. But his researches also lead him to the conclusion that the quantum and field theories of modern physics have virtually no effect upon the theory of knowledge when the latter is considered as the science of the foundations of knowledge. So far as the problem of 'rationality' as a result of the apparent renunciation by physics of the principle of causality is concerned, Dr. May maintains that the relations between quantum theory and the theory of knowledge are artificially obtained by identifying causality with the ability to predict events. He shows at length that logical positivism, inasmuch as it considers all *a priori* knowledge to be tautological and all that is qualitative to be merely subjective, cannot base its conclusions upon the results of mathematical physics, which admits eliminating the *a priori* deliberately, and is therefore not in a position to make any statements concerning that which it eliminates.

Radical positivism is far more concerned with practice and experiment than with knowledge, and is equivalent to a calculus whereby future events in the realm of the inorganic can be predicted, and whereby knowledge—as admitted by the Vienna circle—is identified with control of Nature. But in Dr. May's opinion, knowledge is more than the logical framework of a mathematics of matter, and philosophy must not degenerate into an 'ancilla mathematicorum'.

Dr. Vogel, of Bad Nauheim, who approaches the subject from the point of view of language and philosophy, considers that every advance in knowledge necessarily changes the concept of knowledge. Hence the difficulty in determining epistemologically the nature of objective reality. The concept 'reality' does not belong to science at all—it lies beyond, limits science from outside and changes as the frontiers of science extend. But Dr. Vogel thinks that in its basic structure the nature of reality will always be determined by direct experience of the surrounding world (without its ever being possible to determine exactly in what this fundamental structure consists). The thing to remember and reject is the belief—held by most practising physicists—that abstract calculi constitute the whole of science; especially as the most essential feature, namely, the relationship between abstract quantities and experimental science, can never be expressed in a calculus at all. Quantum mechanics is responsible for the discovery that conditions exist which must be altered by man before he can observe them. So that all we can say is that absolute knowledge does not appear to exist. To which we might perhaps add the qualifying reflection that it may some day become possible to include this fact itself in an extended and more adequate theory of knowledge.

AMETHE VON ZEPPELIN.

Essays in Heredity

(1) The Study of Heredity

By E. B. Ford. (The Home University Library of Modern Knowledge.) Pp. 256. (London: Thornton Butterworth, Ltd., 1938.) 2*s*. 6*d*. net.

(2) The Measurement of Linkage in Heredity

By Dr. K. Mather. (Methuen's Monographs on Biological Subjects.) Pp. ix+132. (London: Methuen and Co., Ltd., 1938.) 4*s*. 6*d*. net.

THESE two competently designed books illustrate, in their different ways, the wide field covered by genetics. They will go far to counteract the erroneous impression now prevalent that genetics is primarily composed of cytological and mathematical complexities. The books obviously reflect the fact that they are written by well-known practising geneticists.

(1) "The Study of Heredity" is designed to give an outline of modern thought on variation, selection, sex, mimicry, human genetics, the species concept and other subjects concerning which many exaggerated views exist in popular imagination. By describing the way in which genetical knowledge has evolved and by developing the main theme of the gene concept, Mr. Ford has effectively put such subjects as evolution, sex, and origin of variation in their proper place. For those who have not had the "advantage of dissecting pregnant mice" (p. 243) the essay, well documented with facts, will provide an excellent introduction to the recent knowledge of heredity. It is unfortunate that the author repeats the fallacious story of the influence of temperature on red-flowered *Primula sinensis*; the red-flowered variety does not turn white at high temperatures as is generally supposed.

(2) Dr. Mather's book fills a long-felt want of practising geneticists who feel insecure in using statistical methods. While the statistical material is fully dealt with, the nature of biological experiments is always fully realized. Quite frequently it is necessary to discover the significance of segregation ratios, to measure linkage and to combine the results from different families. Dr. Mather supplies suitable statistical methods, well illustrated by examples, which, exceptionally for a statistical book, are fully worked out. Novel methods, resulting from the properties of the χ^2 function, are provided for the measurement of heterogeneity, and to meet the difficulties due to disturbed segregation ratios. Finally, a chapter is devoted to statistical methods for the genetical analysis of the refractory material of man. The tables provided enable one to carry out all the more usual computations for genetical experimentation. The non-mathematical reader should be able to extract much help from this clearly written book, which begins with elementary facts, and carries the reader to an advanced stage in statistical methods for genetical work.

F. W. SANSOME.

Frequency Curves and Correlation

By W. Palin Elderton. Third edition. Pp. xi+271. (Cambridge: At the University Press, 1938.) 12*s*. 6*d*. net.

FREQUENCY curves, correlation and sampling together form a subject in which a great deal still remains to be done, notwithstanding the progress that has been made in recent years. Much of the work is necessarily highly mathematical, especially where certain small samples are concerned or where mathematical expressions for skew correlation surfaces have to be discovered. These aspects lie outside the scope of the present work; but, as the author says, there are few subjects which offer greater opportunity for research. Prof. Karl Pearson and his school have been responsible for an immense amount of the work that has resulted in practical success; and only those who have studied Prof. Pearson's original work are in a position to appreciate the greatness of his contribution to statistical science. In this book, the author shows that actuarial statistics can be investigated in the same way as the statistics of biology, anthropology or sociology.

The advantages of any system of curves depends on the simplicity of the formulæ and on the number of classes of observations which can be dealt with satisfactorily. For a complicated expression is no great improvement on the original groups of statistics; and if it breaks down, the statistician is left in great difficulties. Furthermore, if a formula be recognized as a suitable one, there must be some method of finding the arithmetical constants which will produce a good agreement in the particular case. Such a method if it is to be of practical use must be simple, reliable and capable of systematic application. This is all the more important, inasmuch as in practice the advantages of systematic treatment are often overlooked and formulæ which have no scientific basis and no connexion with others suitable in similar cases are used in haphazard fashion by many statisticians.

In this, the third edition of the book, some chapters —notably those on standard errors, the test of goodness of fit and on the correlation ratio-contingency— have been re-written. The notation for moments has been retained. Here, the author treats the 'adjusted statistical moment' as identical with the 'theoretical moment'. For although some writers find it convenient to use distinct symbols for the two expressions, in practical curve-fitting they are equated.

Dictionary of Scientific Terms:

as used in the various Sciences. By C. M. Beadnell. (The Thinker's Library, No. 65.) Pp. x+235. (London: Watts and Co., 1938.) 1*s*. net. Library edition, 5*s*. net.

ONE result of the twentieth-century inclusion of science as a general part of the school curriculum has been the greater interest shown by the reading public in popular scientific literature. This interest is probably most lively in biological subjects, and Surgeon-Admiral Beadnell has therefore done wisely in giving a preponderance to biological terms in his attractive little dictionary. Intended for the layman, the book is as non-technical as the subject permits, and many of the definitions are notable examples of conciseness and perspicuousness. It would, of course, be easy to make a long list of omissions, but Admiral Beadnell has shown a sound judgment in deciding what to put in and what to leave out, and only a curmudgeon could grumble at the quality and quantity of his shillingsworth.

Many readers will regret the complete absence of etymologies, but it is doubtful whether the man in the street—for whose assistance, it must be remembered, the book was written—will share this view. The standard of accuracy is usually high, and though there are occasional slips, they are much less frequent than one might have expected in such an arduous single-handed effort. The author is to be congratulated upon having accomplished a very useful service to the scientific education of the layman, and his book deserves to have a wide sale. A word of praise must be given to the publishers for producing the dictionary so well, and at a price which brings it within the reach of even the most impecunious lover of natural philosophy. The library edition is on thicker paper and is handsomely bound.

The Cultivation of Mushrooms

By Dr. W. F. Bewley and J. Harnett. Second edition, revised and enlarged. Pp. 95+18 plates. (London: Anglo-Scottish Press, Ltd., 1938.) 3*s*. 6*d*. net.

THIS second edition is a considerable extension of the first edition published four years ago. The authors are well-known authorities on the cultivation of mushrooms, and they have made not only commercial cultivators of this plant but also botanists in general indebted to them for a coherent and very practical account of all the processes involved from beginning to end.

It is difficult to imagine any query arising in connexion with the cultivation of the mushroom which remains unanswered in these pages. Apart from details of cultivation, diseases and pests and even cooking recipes are considered. The book is written in a pleasing style, and is illustrated by a few line diagrams and about forty excellent photographs.

Organic Chemistry:

a Textbook for Science and Medical Students. By Dr. Frederick Prescott and Dudley Ridge. Pp. viii+688. (London: University Tutorial Press, Ltd., 1938.) 8*s*. 6*d*.

THIS book claims to cover the organic chemistry required by second-year medical students and by students reading for a general B.Sc. degree; the claim is not exaggerated. The wants of the former are met by sections on carbohydrates, ureides and purines, proteins and fermentation and enzyme action which occupy nearly a hundred pages, and other sections having physiological bearings deal with hydro-aromatic compounds (terpenes, sterols, etc.), indole derivatives and the alkaloids.

The remarks on modern theories of valency (pp. 29–35) may need modification in a future edition, since views change so rapidly.

The R.R.S. *Research*

FURTHER information is now available about the progress in the construction of the R.R.S. *Research*. It may be recalled that the purpose of this vessel is primarily the determination of the magnetic elements at sea, work that was formerly undertaken by the S.S. *Carnegie*, a non-magnetic ship operated by the Carnegie Institution of Washington. The *Carnegie* was unfortunately destroyed by fire, after an explosion, when loading petrol, at Samoa nine years ago. During the intervening period, the magnetic data in certain parts of the oceans have become uncertain; it is known that in some areas there have been considerable changes in the secular variations of the magnetic elements, which are not adequately controlled by recent observations. In certain areas, existing charts of the magnetic declination may be in error by four or five degrees. It is fitting that Great Britain, as the principal maritime nation, should accept the responsibility for the work formerly undertaken by the Carnegie Institution, by constructing and operating a non-magnetic ship.

As in the case of the *Carnegie*, the work of the *Research* will not be restricted to terrestrial magnetism. Certain work in meteorology, atmospheric electricity and oceanography will also be included.

The construction of the *Research*, which was authorized more than three years ago, has taken longer than that of a normal ship. The greatest care is being taken to eliminate, so far as is possible and practicable, all ferrous material from the hull, machinery and stores. The construction of a vessel of so specialized a nature necessarily gives rise to many problems. The Department of Terrestrial Magnetism of the Carnegie Institution of Washington has placed all the information obtained from the *Carnegie* freely at the disposal of the British Admiralty. This generous co-operation should greatly help to ensure the success of the *Research*.

The new non-magnetic ship will be larger than the *Carnegie*. Her loaded displacement will be 770 tons, the length on the water-line being 142 ft. 6 in. The hull is being constructed of teak planks on brass frames, subdivided by eight water-tight bulkheads, and will be copper sheathed. The keel, stem and stern posts are of teak and the false keel is of Canadian rock elm. The ship will have two masts and will be rigged as a brigantine, with a full sail area of about 12,000 sq. ft. Diesel oil engines, of 160 B.H.P., four-cylinder, two-stroke direct air-reversing type, situated aft, driving a two-bladed feathering propeller, will give an endurance of 3,000 miles with a fuel supply of 14 tons of heavy oil. Much research work was carried out by the makers, Messrs. Petters of Yeovil, to reduce the quantity of steel in the engines to a minimum. A bronze alloy is being used extensively and the crank-shaft is of special non-magnetic steel. The anchors, cables and wire for rigging are of aluminium bronze.

The auxiliary machinery comprises two 9 H.P. and one 18 H.P. Diesel engines, for the dynamos, refrigerator, air-compressor and oceanographical winch. The latter will be driven from the auxiliary engines through line shafting and a fluid flywheel.

In order to reduce magnetic material to a minimum, consideration is being given to such matters as iron nails in packing cases, tin containers for food and cigarettes, cooking utensils, cutlery, razor blades, drums for paint and lubricating oil, and typewriter, all of which will be non-magnetic. Water (37½ tons) will be carried in specially designed teak tanks and there will be 120 cubic feet of cold storage.

The upper deck will carry two magnetic observatories, an atmospheric electricity laboratory and an oceanographical laboratory. The marine deflector for the determination of the horizontal intensity of the earth's magnetic field will be housed in the forward magnetic observatory: this instrument is a semi-absolute instrument the instrumental constant being controlled by land observations as frequently as possible. The marine collimating compass, for the determination of the magnetic declination, will be placed on the bridge deck, above the chart room. The after magnetic observatory will contain the marine earth-inductor, which will be driven at a constant speed by a rotary converter, controlled by tuning-fork; the inductor will be provided with commutator and slip rings, so that observations may be made using either a direct current or a string galvanometer. A C.I.W. magnetometer-earth inductor and a Smith portable magnetometer will be carried for land observations and for comparison with the instruments at fixed observatories.

The atmospheric electricity laboratory will be situated immediately forward of the aft magnetic observatory. A potential gradient recorder and a point discharge apparatus will be carried. The potential gradient observations will be standardized by a Wulf electrometer. In addition,

ionization measurements will be made with a modified Ebert apparatus and conductivity measurements will be made with a modified Wilson apparatus.

The meteorological equipment will include thermometer screen with thermometers; mercury barometer, aneroid and barograph; mercury in steel thermographs for dry and wet bulb temperatures and for sea temperatures; an Assmann psychrometer and an Aitken nucleus counter.

An oceanographical laboratory will be provided, aft of the aft magnetic observatory. Echo-sounding apparatus will be carried.

It is expected that the *Research* will be launched in February 1939 and will be ready for her first cruise in the following October. She will carry six officers, four scientific workers and twenty-two petty officers and men. On her first cruise she will first visit Washington, in recognition of the assistance given by the Carnegie Institution; after calling at the South American ports, she will cross the Atlantic and make observations in an area in the South Atlantic between, and south of, Tristan da Cunha and Cape Town. In this area there has been a large decrease in recent years in the secular change of the magnetic declination. The *Research* will then make a double traverse of the Indian Ocean, first on approximately a great circle track to Perth and then returning on a more northerly track, calling at Cocos Island, Colombo, Seychelles, Mauritius and Durban, where she is due to arrive about November 1940. The subsequent course has not been decided upon in detail, but may include a third crossing of the Indian Ocean and a return via the Pacific and the Panama Canal. The Indian Ocean will be the area to be the most completely observed on the first cruise, since it is in this area that there is the greatest uncertainty in the magnetic data.

H. S. J.

Eye and Brain as Factors in Visual Perception*

By Dr. R. H. Thouless

THAT we see with our eyes is known to everyone and has been known for a long time. That we see also with our brains is less generally realized, and the implications of this fact are relatively recent importations into the theory of vision. The full statement of the physiological mechanism of vision would include not only the sensitive retinal surface and the visual areas of the cortex but also the whole system, which includes retina, optic nerve, visual area of the cerebral cortex, and other sensory areas of the brain as well.

Transmission Theory of Vision

It is possible, of course, to study vision in such a way that everything except the activity of the retina is neglected altogether or relegated to a secondary position, and it was in this way that the scientific study of vision began. This is the point of view which we find in the work of Helmholtz and in much of the experimental research into vision which has followed his deservedly great authority. The basic assumption is that the essential process of vision is the formation of an optical image on the retina and its transmission to the visual centres of the brain by means of the optic nerve. Differences between the sensations transmitted to the brain and the finished perception which appears in experience were attributed to the action of the higher processes of judgment and the influence of past experience.

This theory of vision, which we may call the 'transmission theory', has behind it not only the weight of the authority of the great originators of the experimental study of vision; it has also the advantage of being the view of the man in the street. Its truth seems to many to be so axiomatic that its denial may have the appearance of wilful paradox.

It is, nevertheless, now clear that the transmission theory is wrong, and that a wholly different way of approaching the problems of visual perception is necessary if we are not to be led astray. To say this is not to deny the greatness of the achievements of those investigators in the past whose work on vision was guided by this theory. Within a certain limited field, it proved itself a fruitful guide to research. This field was that of the sensory physiology of the retina. If we wish to discover what is happening on the retina, we must arrange conditions of experiment so as to cut out, so far as possible, the complicating effects of the cerebral components of the visual part of the nervous system. This was what was done when the early experimenters made observations through tubes or on black backgrounds. So such workers as Helmholtz, König, Abney and a host of others made a firm foundation for a science of vision in the sensory physiology of the retina. The error, however, has sometimes been made of mistaking the foundations for the completed building. When we get rid of tubes and black backgrounds

* From the presidential address to Section J (Psychology) of the British Association, delivered at Cambridge on Aug. 19.

and open both eyes to look at objects surrounded by other objects, we find that what we see follows other and far more complicated principles than the laws of sensory physiology.

An Alternative Way of Treating Visual Perception

We place on a table an elliptical object with its long axis pointing directly to and from the observer. If his head is directly above the object, it will, of course, look elliptical. If now he moves his head from the position directly above, but still keeping it in the vertical plane passing through the long axis, the object will at first still look elliptical, but with a smaller apparent elongation than when it is viewed from directly above. If the head is now lowered, but still kept in the same plane, the apparent shape of the object becomes nearer and nearer to a circle. It then becomes truly circular and, if the head is still further lowered, the object appears elliptical again, only now with the really longer axis apparently the shorter.

So far everything appears to be as one would predict on the transmission theory by the elementary principles of perspective. Measurement of the actual angles at which these various appearances are found reveals, however, a considerable discrepancy from the expectations aroused by the transmission theory. At the height, for example, at which the ellipse looks circular, it is found that the retinal image is not of a circle but of an ellipse with the vertical axis much shorter than the horizontal, that is, an ellipse flattened in the opposite direction. It is as if the shape that is seen (the phenomenal shape) is in between the real physical shape of the ellipse and the shape that is projected on the retina (which we may call the stimulus shape). The expectation on the transmission theory would be that the stimulus shape and the phenomenal shape would be identical. Plainly they are not, and the discrepancy is large enough to show clearly without any great refinement of measurement.

We are led from consideration of this experiment to the same conclusion as was arrived at by Werthiemer as a result of his experiment on phi-movement, that the 'sensation' corresponding to the conditions of local retinal stimulation, as an element in a complex perception, is a mere fiction. Although it is clear that the conditions of local retinal stimulation affect the resultant perception, we can find no trace of evidence that they do so by being transmitted to the brain as 'sensations'.

The transmission theory is easily intelligible because it can without difficulty be explained by a physical analogy. Photographs might be transmitted telegraphically by forming an image on a plate made up of a large number of small photo-electric cells each of which is connected by a wire with a corresponding reproducing cell at the other end. This is not, of course, the method actually used for the telegraphic transmission of photographs, but it is physically a possible one. If the receiving electric cells are replaced by the retinal organs, the transmitting wires by the fibres of the optic nerve, and the reproducing cells by the nerve cells of the visual centres of the cerebral cortex, we have a perfect analogy to the physiological process of vision on the transmission theory.

Yet this advantage of simplicity and easy intelligibility must be given up if the transmission theory does not fit the facts. We have so far criticized it only in connexion with one experiment. Perhaps this will be a convenient place to summarize the whole case against it.

First, there is a physiological difficulty as to the mechanism of transmission. Such a method of transmission as is suggested by the above analogy would require a number of wires equal to that of the receiving cells. This condition is not fulfilled by the visual system, since the number of retinal end-organs is two hundred times as great as the number of fibres in the optic nerve.

Secondly, a breach in the transmitting part of such a system would lead to a corresponding gap in the received picture. This expectation is not fulfilled in vision. We might explain away on the transmission theory the fact that we do not see a gap in the part of the monocular visual field corresponding to the blind spot, but Fuchs has shown that similar completion may take place over a blind area of the retina caused by an acquired destruction of part of the optic nerve.

Thirdly, if this theory were true, it would be necessary that differences in the picture at the sending and at the transmitting end should always accompany one another. The experiment already discussed has given one example of that not being the case, since the impression of a circular shape may be given either by the circular retinal image given by a circular object at right angles to the line of vision, or by a retinal image which is a flattened ellipse if this is made by an object which is itself an elongated ellipse viewed at a suitable angle of inclination.

There are plenty of other examples of this in visual perception; indeed, except in those conditions of simplified perception which were characteristic of the early investigation of visual 'sensations', exact correspondence between the details of the retinal image and of what is perceived is the exception rather than the rule. In Rubin's reversible figures, for example, we may have a pattern which is seen either as a row of black T's on a white ground or as a row of white fleurs-de-lys

on a black background. Thus we have a single stimulus pattern on the retina giving rise to two wholly different perceptions. The after-image of a circle, moreover, will look large or small as it is projected on to a far or a near object respectively, although the area of retinal activity remains unchanged. If a subject seated below the object glass of a projection lantern looks at a picture projected on to an inclined screen, he sees the picture as distorted, although it is easy to demonstrate that his retinal image is identical with that which he would have received if the screen had been at right-angles to his line of vision.

Such facts as these are not easily reconcilable with the theory of simple transmission of a retinal picture to the brain. That there is a close relationship between the condition of physiological stimulation of the retina and of the resulting pattern of visual perception is, of course, obvious and is denied by nobody, but the relationship may not be of the kind suggested by the analogy with telegraphic transmission.

A better analogy for the modern view of perception is, I suggest, the construction of one of the charts published with weather forecasts. The lines of equal pressure on the charts are constructed from information received from various land stations and ships, just as the perceptual picture constructed by central activity depends on information received from the sense organs. If no information as to barometric pressure is received from a certain area, this does not mean that the corresponding area must be left blank, but that the person constructing the chart must fill it up by guess-work, which he generally does by constructing smooth curves consistent with the other information. In the same way, in Fuchs's experiments, it was found that central perceptual activity tended to fill in areas from which no information was received from the retina by simple completions providing 'good continuation' with the figure received on the rest of the retina.

The analogy of the construction of a weather chart suggests a possible way of looking at the process of visual perception which is alternative to the transmission theory and which, I think, gives a much better account of the experimental facts. It regards the mind (or the brain acting to some extent as a unitary whole) as active in perception, responding to information given by the sense organs and not merely reproducing a pattern of stimulation from the sense organs.

Individual Differences in Visual Perception

Let us now return to the experiment with the inclined ellipse to note a particular feature in it which is, I think, a characteristic of the perceptual processes that has often been ignored. This feature is the wide range of individual differences. Apart from such obvious differences as errors of refraction, colour-blindness, etc., the optical system of different individuals' eyes and consequently the conditions of local physiological stimulation on the retina for a given arrangement of external objects is very much the same. The perceptual responses of different individuals are, however, widely different, so that any two of us in the same physical surroundings may create from them a very different phenomenal world.

If two or three people perform the experiment I have just described, we shall find that the height at which they say the apparent shape of the inclined ellipse is circular is different to an almost incredible extent. One may see the ellipse as circular when his head is only a few inches from the table, so that his retinal image is of a very much flattened ellipse, while another sees the ellipse as circular when he is looking well down on it, so that his retinal image is itself not very far from circularity. The first individual shows a very great effect of the real shape of the ellipse in determining its apparent shape, the second shows a relatively smaller effect of the real shape on apparent shape.

That these are real individual differences and not merely accidental variations in measurement is shown by the fact that they show great consistency from one time to another. I once retested, after an interval of two years, a group of twenty-five subjects for each of whom I had measured the apparent shape of an inclined object. They differed widely amongst themselves at each test, but the agreement between the two sets of tests was extraordinarily high. The coefficient of correlation was 0·92, which is as high as one expects to get in psychological measurements.

There are, then, genuine and large individual differences between different persons in the apparent shapes of inclined objects. We may add that there are similar individual differences in the apparent sizes of objects at different distances and of the apparent whiteness of objects under different illuminations. In both of these cases, the same general law holds. If an object is moved to twice its previous distance from our eyes, it does not look half its previous size. It may, for different individuals, look threequarters of its previous size or nineteen-twentieths. With rare exceptions (which I shall mention later) the law holds that the apparent size is in between the retinal size and the real size. In the same way, if a piece of white paper is put into shadow so that it reflects less light to the eyes than a brightly lighted piece of black paper, it does not necessarily look less white than the black paper, although it may do so if the shadow is very deep. The seen whiteness is

in between the 'real' whiteness and the stimulus intensity of the retinal image. Again, in this tendency to see objects in their real whiteness irrespective of illumination, we find wide individual differences. I have suggested that we should call these effects "the tendency to phenomenal regression to the 'real' characters of objects".

If we test a group of subjects in their tendency to phenomenal regression for shape, for size, and for whiteness, we find that those who have a large tendency to see the 'real' size of an object tend also to have a large tendency to see the 'real' shape and the 'real' whiteness. The correlations between these tendencies are about 0·6, which shows that they have a considerable factor in common. We can thus speak of individuals as having high phenomenal regression if their perceptions of apparent shape, size and whiteness are largely determined by the 'real' characters of the objects looked at, while those whose perceptions are determined relatively more by the conditions of retinal stimulation (that is, who see objects getting much smaller as they go farther away, and so on) we shall describe as those of low phenomenal regression.

Practical Consequences

It may be asked whether the kind of thing we have been talking about has any practical importance. It certainly may have. We test for such differences in the sensory physiology of the eye as colour-blindness because they may lead to practically important incapacities, and it is very likely that individual differences in the cerebral side of perception may also affect an individual's practical capacities. Some years ago I suggested that a person of high phenomenal regression might be expected to drive a car more easily through traffic than one with low. He sees a gap in the traffic in something near its real size before he drives up to it, whereas the person with low phenomenal regression sees it as smaller than it really is when it is at a distance. Neither, of course, adjusts his driving to the apparent size of the gap; both must make a judgment as to its real size. The person with low phenomenal regression has, however, a much larger gulf between appearance and reality to bridge by means of judgment. Judgment being a slower and more uncertain process than perception, he may be expected to drive through gaps with more difficulty and less certainty than the individual who can trust to his immediate impression of size. The individual with high phenomenal regression may therefore be expected to drive more easily and better through traffic. This prediction appears to have been justified by a research in motor-car driving by the National Institute of Industrial Psychology, when it was found that a test of phenomenal regression showed a correlation with driving ability.

The effect of drugs on individual organization of phenomenal space is an interesting problem. I have made only preliminary experiments on one subject in the hope that someone better equipped to experiment on drugs will take the inquiry further. The indication I obtained was that (as might be expected) alcohol decreased phenomenal regression while caffeine increased it. I think that it might be worth while for those investigating the effect of alcohol on motor-car driving to consider the possibility of disturbance of spatial perception as well as of speed of motor responses. That a change of spatial organization can affect driving I am sure from personal experience. I was driving one night towards Buxton suffering from the effects not of alcohol but of fatigue (which probably affects spatial organization in the same way as alcohol). At one point, I found my perception of the road so much disturbed that I had to stop my car and get out. The road seemed to narrow almost to a point in front of me; I seemed to be driving not on a parallel-sided track but into a funnel. I recognize the condition now as one of extreme reduction of phenomenal regression. One result of this condition was an almost irresistible impulse to drive in the centre of the road. A persistent tendency to drive on the crown of the road is a common fault; I suggest it may be a fault characteristic of an individual with low phenomenal regression, and that if this were proved to be its origin, an understanding by the driver of the cause of his fault would put him into the way of correcting it.

Conclusion

The change that has taken place in the psychological study of vision during the last twenty-five years may be expressed in a summary way as a change from the time when it was treated as if vision were a function of the eye alone to a time when the eye and higher centres are regarded as co-operating in visual perception. The psychology of vision is not and cannot be merely the sensory physiology of the eye. At the present time, these wider aspects of visual perception offer a more fruitful field of research than do those of sensory physiology which have been so adequately dealt with in the past. Particularly, I should like to suggest that individual differences in visual perception and the statistical study of these differences is a field the surface of which has scarcely yet been scratched. Let us hope that in the next twenty-five years, psychologists may be as successful in resolving the many remaining problems of visual perception as were the great Helmholtz and his contemporaries in making a scientific study of the sensory physiology of the eye.

Contacts of Science with Social Problems

By Prof. G. A. Boutry, Directeur du Laboratoire d'Essai, Paris

PROSPEROUS States and societies are in a state of statistical equilibrium somewhat comparable, for the purposes of argument, to the state attained at the end of a limited chemical reaction. If we consider our present civilization, such a stable state seems to exist no longer, and the departure from 'moving equilibrium' must, indeed, be large, since everybody agrees about its existence. . . . That one of the causes of this new—and uncomfortable—state of things is to be found in the ever-accelerated industrial and scientific development, or rather in the social, sentimental and ethical aspects of our world lagging behind that development, few people would now care to deny.

This means that science—the word is here used to signify the natural sciences—has slowly come to have a social and *political* importance of the first magnitude. There is no reason to insist upon this idea, which has been often stated and discussed in NATURE. A century ago, politics and science had only a nodding acquaintance; the influence of the second on the first has since grown more and more powerful, more and more *direct*, until at last a development which could have been foreseen so early as the beginning of this century has taken place. Men, in various countries, speaking severally, have claimed, in the name of science, a share in the ruling of nations. This claim—which has had its echo in the columns of the present journal—is far reaching and important enough to attract study.

Common sense points out that 'Science', being only a spiritual construction made up of countless sheets of thought laid up and sealed by countless dead or living men, has no separate and discrete existence, no personality, no will and no power to act. Scientists, being men, possess those properties; men who are not scientists also do. Therefore, when we hear someone speaking 'in the name of science' about political matters, three possibilities are to be considered, namely, (1) the speaker is a politician influenced by scientific ideas; (2) the speaker is a scientist influenced by political or non-scientific ideas; (3) the speaker is a scientist interested in a new field of application.

In the first instance, by the term "politician influenced by scientific ideas", we allude to those men whose speech has caught the knack of scientific wording, but whose minds continue to run along the well-worn political grooves. The political language has a marvellous way of generalizing and distorting ideas, principles and laws. We have seen, during recent years, outstanding examples of such a technique, and the world is teeming with such attempts. Racism is nothing else than a provocative distortion and generalization of well-known biological results, yet it seems to have become powerful enough to rule a great nation. Another and much older example of the curious sentimental reactions and upheavals which a badly understood scientific theory may originate is to be found in the anti-Darwinist movement in the United States, which, so I am told, is still discussed there from a religious point of view. It is unnecessary to give more historical examples of this kind: they are well enough known. These contacts between misunderstood science and politics are not the principal object of the present paper. Indeed, they would be dismissed with contempt if their advent was not, in itself, a danger to science, a risk of creating, in the mind of men, uncalculated aversion for the innocent techniques thus misunderstood or misapplied.

Far more interesting is the same claim, when it is made by real scientific workers. It is not intended here to contest the principle that, if a little more scientific thinking were used in the ruling of countries, some blunders would be avoided and some progress made. What has to be considered is the claim as to a proposed scientific experiment and, treating it as such, to find whether that experiment has any limitations (voluntary or otherwise), whether it can be stopped and started again at will, whether, finally, it will endanger in any way the human commonwealth already acquired. It is at once evident that caution is necessary: the experiments of a mathematician are dangerous only to his paper supply: those of a physicist or chemist may raise the roof of his laboratory and reduce him to small particles; those of the biologist or pathologist may be fatal to thousands of people. What can be said of an experiment in the science of ruling nations? Wars have shown that mistakes in this art have led to the death of millions and the misery of generations; it is conceivable, also, that they may be dangerous to the spiritual qualities of mankind, since we know next to nothing about this side of things.

It follows that great pains must be taken to ascertain that the claim we are considering is pure. We have seen Governments making a masquerade of scientific principles. Scientific workers, being human, might do the same and could be infinitely more dangerous, since the disguise would be much better worn. . . . If a man of science is moved on such a course by purely personal motives or feelings, such as money, lust of power, family politics, etc., the process is generally petty and cheap, as it is in ordinary political life; and the activities of the man will cease when he reaches his small goal. Very different is the result of a metaphysical bias. The mixture of metaphysics of any kind with scientific theories and results is constantly occurring in second-rate scientific minds; and it is very easy to understand: such a mixture leads to single-minded pictures of the world, generally easy to grasp; these appear endowed with absolute, fixed, immovable properties, rules and laws; this again, is very satisfying to the human mind, as creating what one of this school aptly termed a 'rational religion'. One is led, along such a line of thought, to the idea that science rules the world, and that no principle of hers may be transgressed by Nature. From such a conclusion, it is evident that rules of government may be deduced and that further experiments to prove them are unnecessary: this is why such schools of thought (which are as old as science itself) are always unable to admit failure: if facts disappoint their hopes, facts are wrong; and if people do, people should know better, or had better die.

The first modern trials at 'scientific' interference of this kind have already happened. One, born in the United States, based upon a misunderstood conception of the principles of thermodynamics, was called technocracy. Another is slowly developing in the U.S.S.R., where the simple creed of Marxism is slowly being replaced by the metaphysic faith known as 'empirical materialism'. Another, born in France recently of the same principles as the Russian theory, can be followed and studied in its rapid growth in the sayings and doings of some well-known physicists of that country. The 1937 Congress of the Palais de la Découverte afforded, in its opening speeches, some good examples.

From these views it would be gathered that science, supreme master, is not the servant of men, but should be served by them: thus new gods are born in fair disguise; they are no longer anthropomorphic, but they are still man-made. It is indeed a shattering thought for those who hope in the ultimate progress of humanity to remember that misunderstood Christianity, in old days, was a foe of science, while a new religion can be now found in the principles of thermodynamics and statistical mechanics. It is another shattering thought to reflect that most of the men who fall into such errors are sincere, and therefore powerful leaders of men. Have we made no moral progress since the spectacular failure of Auguste Comte, and of his "religion de l'humanité"?

Let us now consider the last kind of claim, that laid by fair-minded men who consider that a new field of application will be shortly opened for scientific thought through the helpless state of most political Governments in this our world. Indeed, we all feel it is highly desirable and urgent to make a start. But we are also convinced that prudence and humility must be the order of the day—rashness and pride would be fatal to this new-born cause. We must always remember that this application of scientific training, reasoning and principles to a field where the work already done is scarce and of a fragmentary character will be the biggest extrapolation that science has ever attempted.

It must always be remembered that experiments may fail; and while being ready to accept such failures and take them into account, we must keep before our mind the fact that social experiments are costly, and that failures must be few and far between; in ancient days experiments on living men were impossible—they are still rare and difficult: so will be experiments on nations. Also, we must never forget that this new development of science must introduce new variables into its reckoning: that it must be human, while remaining impersonal, that it must build a world not only efficient, but also happy. From this point of view problems, such as that of human liberty (its scope and limitations), sexual relations, the fostering and development of intelligence, appear as peculiarly dangerous, since few more mistakes can be allowed in their treatment. Indeed, had science only to deal with the financial conduct and foreign relations of nations, its task would appear almost light compared with the heavy burden it is now preparing to shoulder. It is, however, certainly high time for the proposed organization of the study of social relations of science to be established, and NATURE is to be congratulated since this journal was the first to urge its necessity.

[To prevent possible misunderstanding, it should be stated that the above article by Prof. Boutry was written by him several weeks ago, and submitted for publication in NATURE long before the recent Cambridge meeting of the British Association, at which it was decided to constitute a new Division of the Association to be concerned with social relationships of science.—Editor of NATURE.]

News and Views

A Founder of the Institution of Electrical Engineers

ON September 5 occurs the centenary of the birth of Major-General Charles Edmund Webber, who in 1871, with Colonel Sir Francis John Bolton (1831–87), was instrumental in founding the Society of Telegraph Engineers and Electricians, since 1889 the Institution of Electrical Engineers. Webber, who was the son of an Irish clergyman, passed through Woolwich Academy and in 1855 received a commission in the Royal Engineers. After service in India, he became an instructor in military surveying at Woolwich, and in 1866 was attached to the Prussian Army to report on engineering operations and military telegraphs. His knowledge of the latter led to his being lent to the British Post Office in connexion with the organization of the telegraph service, and it was while engaged on this service in 1871 that with Bolton he founded the Society of Telegraph Engineers, of which Sir William Siemens became the first president. Bolton was for some time the honorary secretary, while Webber was elected to the presidential chair in 1882. He had just previously, in 1879–80, been through the Zulu War, and in 1881 had served as British Commissioner at the Electrical Exhibition. In 1882 and 1884 he again saw active service, this time in Egypt, and in 1885 retired from the army with the rank of major-general. He was afterwards connected with several electricity supply undertakings and was elected a member of the Institution of Civil Engineers, being, it is said, the first military officer to qualify for election. He died at Margate on September 23, 1904.

Protection from Air Raids

THE scheme of air raid protection prepared by a committee of scientific workers, including Profs. J. B. S. Haldane, J. R. Marrack and J. B. Bernal, working in conjunction with engineers and medical men, and recently submitted to the Home Office, presents what may be regarded as a scientific and technical view of the best preparation against the eventuality of air raids. The scheme, which is also being placed before the L.C.C. and all the London Borough Councils, has been prepared at the instance of the Science Commission of the International Peace Campaign and might with advantage be studied by all who take an interest in this matter. Because it combines an important strategic centre containing three main line railway termini, a better-class residential district with many open spaces, and a densely packed working-class area, the Borough of St. Pancras was chosen as typical of the conditions to be dealt with and has been made the basis of a typical scheme worked out in broad details. Experience in Spain and China shows that air raids now are of a very different character from those of the Great War and that the civilian population has become a definite objective. The scheme is based on the assumption that all four types of attack—machine guns, gas, incendiary bombs, and high explosive bombs—may be used either separately or in conjunction, and figures are quoted as to the destructive and penetrative powers of these weapons.

THE Commission proposes the evacuation to the country of children up to fourteen years of age, the mothers of infants, people over seventy years of age and the sick and infirm. For the rest of the population shelters are proposed, and these take the form of tunnels in the London clay 50 ft. below the surface, of inverted U section and lined with steel sheeting. In the design of these, provision has been made for every necessity which it is possible to foresee. Some of the suggestions made deserve consideration on the broader ground of their intrinsic value in times of peace; for example, that hospitals should now be built in the country, and that school camps be prepared for children of school age. Such a scheme as is here proposed is necessarily of a tentative nature, but the work of the Committee has reached the stage at which its publication is of value to the public and the details of the scheme are sufficiently clear-cut to stimulate criticism, suggestion and discussion which will lead to modifications and improvements. Copies of the memorandum can be obtained (price 3*d*.) from F. J. Sander, 85 Beechwood Road, Sanderstead, Surrey.

Radcliffe Observatory, Pretoria

NEWS has recently been received from the Corning Glass Co. that it has been successful in the third attempt to make a Pyrex disk for the 74-in. reflector of the new Radcliffe Observatory, Pretoria. The glass is now being shipped to Newcastle, where grinding and polishing will be commenced immediately by Sir Howard Grubb, Parsons and Co. Meanwhile, work on the site at Pretoria is proceeding satisfactorily, and erection of the turret and the telescope mounting should be completed by the end of this month. The turret steelwork is all assembled, including the shutters, and the outer sheeting has been fixed in position. The telescope itself is practically entirely erected, despite some difficulty which was encountered in procuring lifting tackle sufficient for handling the heavier parts, especially for the polar axis, which when fitted with its circles, etc., weighs 16 tons. The tasks now remaining are concerned chiefly with the electrical equipment. Subsidiary apparatus, all of new design, is still under construction in Great Britain. A measuring machine for spectrograms has been finished and has passed thorough tests, a microphotometer is near completion, and work is in active progress on a Cassegrain spectrograph. Dr. T. Dunham, jun., of the Mount Wilson Observatory, is preparing plans in conjunction with the Radcliffe

staff for a large spectrograph of very advanced design, which it is hoped will be installed at the coudé focus very soon after the new reflector comes into operation.

Biblical Botany at the Hebrew University

STUDY of the flowers of the Bible has just been introduced to the Hebrew University at Jerusalem as a subject for students, who are showing considerable enthusiasm for it. Coupled with biblical botany is the study of Jewish and Arab plant-lore. Dr. Ephraim Hareubani is the lecturer, and he brings to his task thirty years of research into the flowers and plants mentioned in holy scripts. Together with his wife, also a botanist, he has collected almost all the specimens named and, using Mrs. Hareubani's own methods of preservation, has placed the whole collection in the University's Museum of Biblical Botany. He has identified and classified all the plants of ancient Palestine, Syria and Babylon mentioned in the Bible, the Hebrew Talmud and later Jewish writings. A conspicuous feature of the Museum of Biblical Botany is the fresh-looking appearance of the permanent exhibits which, without pressing or bathing in liquids, seem as though they have just been plucked, and retain their original colour and greenness of stalk. They are displayed in their natural groups in sealed cupboards. Among the many curious plants may be mentioned a species of *Capparis*. This blooms, matures and dies in a single day, and, by the exercise of considerable patience and vigilance, Dr. Hareubani has been able to show it in a series of half-hourly stages of growth.

STUDY of botany on a scientific plane was first begun in Palestine by Dr. Alexander Eig, late director of the Department of Botany at the Hebrew University. His researches, from 1921 onwards, led him to Syria, Turkey, Kurdistan and the desert tracts, and he built up a comprehensive collection of Near Eastern flora. The Palestine plants he classified according to the geographical and climatological types of the world groups (the country comprises two different floral regions), and he published a remarkably detailed phytogeographic map of Palestine. According to Faba Turovlin, broadcasting from the Jerusalem wireless station, "by following Dr. Eig's observations on the subject, the character of any particular district in Palestine may often be learned from the study of its plants, and in some cases from the occurrence of a single plant only". There is now periodically published a *Palestine Journal of Botany*.

Excavation of a Hill Fort in Sussex

THE hill fort or camp at Mount Caburn, near Lewes, which is under excavation by the Brighton and Hove Archæological Society, continues to yield interesting results. The investigations have now revealed the character and constructional history of the ramparts in some detail. According to a report on recent work (*The Times*, August 25), excavations in the upper rampart show that, when first constructed, it was retained by a line of posts and a net palisade. A channel in the chalk indicates the line of the palisade. The second stage of the outer rampart, which covered the final period of occupation of the camp, is indicated by the fact that the original rampart was reinforced by a mixture of chalk and black mould. Post holes show that the rampart was further strengthened by fresh timbering. On the south side of the gateway a long cut has shown that the inner ditch had been filled up by the slipping of the inner rampart. Occupation floors of huts are clearly evident. There is no trace of occupation during the neolithic period, but a small piece of bronze has been found.

Archæology and the Unemployed at Oxford

OXFORD, like the Irish States (see NATURE of June 11, p. 1041), has made use of measures for the relief of unemployment to further archæological studies. Voluntary labour from the Oxford and Wales camps of the Universities Council for Unemployed Camps has carried out excavations on Farington Clump during two seasons, proving it to be the site of the Adulterine Castles raised by Robert of Gloucester against King Stephen. In 1937, excavations were begun on a Romano-British and early Saxon cemetery site at Frilford. Here, under the direction of Dr. L. H. Dudley Buxton, members of a camp near Eynsham, consisting of ninety men from South Wales and twenty-five university men, worked daily on the Romano-British area. They located six graves and established the north-western limits of the cemetery. A hoard of thirty coins made it possible to date the site with some precision. The Saxon area is of special interest, as it is one of the sites, rare in Britain, which was in continuous occupation during the period of Saxon penetration. Excavations are being continued at Frilford and on a site in the north of England. The men, some of whom have been out of work for years, showed a ready response, both technically and intellectually, to archæological training, and their interest in the results was keen. The three weeks in camp produced a marked improvement in physique. Funds for the continuation of this work are urgently needed, especially as the applications from clubs for the unemployed are increasing. Contributions may be sent to the treasurer of the appeal, Mr. J. Kelly, 16 Charlbury Road, Oxford.

Insulin Treatment of Diabetes

PROF. CHARLES BEST, of Toronto, delivered the twelfth Stephen Paget Memorial Lecture at the annual general meeting of the Research Defence Society on June 9 (*The Fight against Disease*, **26**, No. 3; 1938). Prof. Best is the co-discoverer, with Prof. Banting, of the anti-diabetic substance known as 'insulin', now universally used for the treatment of the disease, and the subject of his lecture was "Insulin and Diabetes: The Present Position". The stages in the discovery and preparation of insulin were first outlined, and Prof. Best then described recent modifications—protamine- and protamine-zinc insulins—by the use of which the effect of the dose is prolonged. He next discussed the influence of insulin

treatment upon diabetic mortality in Canada, where since 1922 insulin has been available for everyone who wished to have it. In certain age groups the mortality from diabetes is not coming down; it may even be going up, because there are now many more diabetics who reach the older age groups. When these people die, as even the diabetic must, the cause of death is usually stated to be diabetes. But in the earlier age groups, up to fifty years, diabetic mortality has markedly declined. From 1891 until 1920, before the use of insulin, the percentage mortality among diabetics up to 50 years of age remained steadily at about 45 per cent, that is, nearly half the cases died. Since 1922, when insulin began to be used, the mortality first steadily declined, and for 1929–33 has been about 15 per cent (statistics for Ontario). This great saving of human life, as well as of much suffering, must be ascribed to experimental work done upon animals, and Sir Edward Mellanby, in proposing a vote of thanks to the lecturer, bewailed the fact that it is necessary even now for scientific men to come forward and justify the use of animal experiments.

Measurement of Mechanical Power

IN a lecture on the measurement of mechanical power by Dr. C. V. Drysdale, delivered to the Junior Institution of Engineers, and published in its *Journal* of August, he points out the urgent demand there is for the accurate measurement of mechanical power under service conditions and how impossible it is to judge the relative merit of various mechanical devices without knowledge of this and the economy of the fuel used. In mercantile shipping, this is fully recognized and has led to great improvements in torsion meters. Many engineers are now studying the performance of aero engines especially at high altitudes, and this involves the making of power measurements, more especially at high altitudes during actual flight. The Royal Aircraft Establishment has now designed and constructed a mechanical power (watt) meter for air-screw testing. Utilizing the principle that a constantly excited generator produces an electromotive force proportional to the speed and that the torque is proportional to the current, it has constructed a mechanical power meter which acts satisfactorily. Alternating current at a frequency of 1,500 is supplied by a small wind-driven alternator on the plane. Records are given which prove that accurate testing of power during flight has been accomplished. Dr. Drysdale states that, of the millions of mechanically propelled vehicles in use, it is probably safe to say that not one per cent of their engines are working with anything like their maximum efficiency. One has only to watch the tuning up of an engine after decarbonization and regrinding of the valves to realize how much it depends upon the almost unaided judgment of the mechanic.

The Agricultural Research Council

THE third report of the Agricultural Research Council (London: H.M. Stationery Office. 5*s*. 6*d*.) surveys the research work aided from State sources during the period October 1935–September 1937. Besides its co-ordinating functions in respect of much of the work carried out at the various research institutes in Great Britain, and its advisory capacity as regards the Development Fund, the Council now possesses a field station of its own at Compton, Berks, where it is proposed to establish disease-free herds of cattle, pigs, etc., and to provide opportunities for experiments under scientifically controlled conditions on a larger scale than is ordinarily possible at any individual research institute. The first group of experiments with cattle will be concerned with contagious abortion and will involve the testing of various vaccines. Among other problems to be investigated are the causes of the unduly high death-rate among pigs and poultry, particular attention being paid to fowl paralysis as regards both its hereditary and its infectious aspects. A new interest of the Council was marked by the setting up of an equine research committee to deal mainly with horse diseases, a substantial aid for which is being provided by the Racecourse Betting Control Board. The review of the research work on foot-and-mouth disease recently undertaken by the Council is particularly appropriate in view of the serious outbreaks this year. The general conclusions are that in spite of the high cost and slow progress of the investigations, they should be continued in the hope that eventually measures will be found that will make possible some modification of the slaughter policy.

League of Nations: Social Surveys

THE report on the work of the Advisory Committee on Social Questions of the League of Nations in 1938 (Second Session) refers to the proposed review of social questions to be published quarterly, and contains, in addition to information regarding the League's work on social questions, special articles by experts and selected bibliographies on social questions (C.147.M.88,4. Pp. 28. Geneva: League of Nations; London: George Allen and Unwin, Ltd. 1*s*. 3*d*.). On the recommendation of a sub-committee, the Committee has decided to place three new subjects on its agenda: the principles adopted in the organization and administration of welfare work among the young, including social assistance; the training of persons engaged in social work; and family desertion. The first study is to be limited, in the first instance, to a selected number of representative countries, emphasis being placed on the study of principles adopted in organization and administration of the administrative machinery. The study on training for social work will take note of the work already carried out by the International Committee on Social Service Schools in regard to the participation of universities in the training of social workers, and will deal with other aspects, such as the extent to which different groups of social workers, including voluntary workers, are trained, and the training given. Developments in child welfare in the past year are summarized in the report, which includes reports from the liaison officers with the International Labour Office and the Health Organisation, and formulates the broad principles arrived at from its investigations on the placing of children in families.

Surveys of Town Planning

A BROADSHEET recently issued by Political and Economic Planning (P E P) reviews the report of the National Survey and National Planning Committee of the Town Planning Institute, the first really thorough and informed analysis of the reasons for the wasteful and undesirable development of the land which is still occurring all over England. Together with the Bressey report on the Highway Development of Greater London, it makes a major contribution to the national planning of the use of land, and as such has claims on the attention of all scientific workers who are concerned with the social problems of our technical civilization. Essentially the primary task is one of co-ordination—of fitting together the requirements of many different and often rival users of land, and where necessary choosing between them. Pointing out that there are national aspects of planning urgently requiring comprehensive study, decision and action, and that the existing planning system is quite inadequate to deal not merely with these national aspects but even effectively with the broader regional requirements, the report recommends the creation of a National Planning Commission.

THE functions of this Commission would include the compilation and collation of all relevant information bearing on the use, development and planning of land from a national point of view: advising and co-ordinating Government departments, statutory undertakers and highway authorities in their use and development of land; providing planning authorities with constructive advice and guidance, such as the Minister of Health is prevented by his quasi-judicial position from providing, watching their planning operations, and making appropriate representations to the Minister of Health when necessary. The Commission would also keep the general progress of planning under review, investigate its problems, defects and delays, frame proposals for overcoming them and generally advise the Minister and the Government on the legislative and administrative development of the planning system. As a basis for its activities and as a background for local and regional planning, it would formulate a national plan or policy on broad and flexible lines for the allocation of major land uses and developments. The wisdom of this proposal is emphasized by the revelation in the Bressey report of the widespread damage being done in the absence of such measures, and the indictment it contains of recent official policy in regard to roads.

An Adolescents' Charter from Manchester

THE Federal Council of Lancashire and Cheshire Teachers' Associations has recently issued a "Report on Entry into Employment" which includes a formulation in fourteen points of what the Council regards as "a working basis under the conditions at present prevailing in the industrial world and under the Acts dealing with school leaving and the regulation of factories and workshops now in force". Among the more significant of the fourteen points are: vocational guidance for all and, as a means for ensuring this, insistence on the submission at regular intervals by every juvenile advisory and choice-of-employment committee of reports to the appropriate authority (in one area 23 out of 24 such committees were found to have ceased to function); entry into employment of a school leaver to be preceded by medical examination and report, co-ordinated in each case with the child's 'health-sheet'; all school planning to include "equipment suitable for the use of older persons, and such amenities and arrangements as will appeal to the developing mind and character of the ex-pupil" (especially in rural and detached areas); continuative education for all, and *definite* arrangements to induce all school leavers to continue their education, whether in technical, commercial or art schools or in less exacting or more general courses; recreative facilities to be provided in connexion with all further education. The report dwells on the distressing waste of much of the good work done in the primary schools owing to lack of effective means for ensuring further education up to the point at which the adolescent attains to the will and capacity for self-instruction. "In the interval between leaving the primary school and the desire to proceed further, the foundation laid in the primary school has been lost since no means or care have been taken to retain it".

The National Central Library

WE read in the daily newspaper that "the lecture system has been obsolete ever since the invention of printing". Notwithstanding, the system has led at least to the demand for public libraries. The need arose from the establishment of mechanics' institutes and the foundation of lectures for adult education. Actually the public libraries movement dates from the Select Committee of 1845, which authorized a ½*d.* rate for their maintenance. The corner stone of this movement is the National Central Library, unifying and binding together, as it does, the independent units of the system. The National Central Library constitutes a central bond, through which the books in any one library are made available for use in any other. The annual report for 1937 shows that, in addition to the ten million books contained in the urban and county libraries, the National Central Library has built up gradually a supplementary reservoir of another ten million books, which may be borrowed from university libraries, and those of learned societies and similar institutions.

COMMENCING as an experimental library for workers' educational classes at Toynbee Hall in 1914, the Library was given a Royal Charter, as recommended by the Public Libraries Committee in 1927. This report also recommended that the Science Library at South Kensington should be the principal source on which the National Central Library should rely for the loan of books needed by students of science and that the Science Library should be made as complete as possible. Thus the National Central Library has become the centre of a national library movement, with which nearly all the public, university and other libraries in Great Britain are

associated. The past year has seen the completion of a series of more self-contained regional library systems. Such a vast scheme of mutually supporting libraries must depend for its greatest efficiency on the maintenance of central catalogues. Union catalogues by authors of the books in the affiliated libraries are being compiled at various centres. The total number of entries in that at the National Central Library has reached ¾ million. A subject-catalogue of books and original articles is maintained at the Science Library and has reached 2¼ million entries. A "Union Catalogue of the Periodical Publications in the University Libraries of the British Isles" was published in 1937. The total number of books lent during that year was nearly 140,000, of which it is significant that some 400 were supplied to foreign libraries.

Prices of Biological Books in 1937

FOR twelve years the *Quarterly Review of Biology* has analysed and compared the cost to Americans of biological books, based upon the prices of all such received for review by the *Quarterly*. The analyses have produced some interesting figures regarding the relative cost of books produced by different nations, and to some of them attention has been directed in NATURE. In point of price, German books are still the most expensive, despite the announced policy of German publishers, a German average of 1·95 cents a page comparing with 1·27 for British books, and 0·85 for French. Than the last the only cheaper books published are those issued by the British Government (0·34 cents a page) and the U.S. Government (0·16), but since the last three categories are often published in paper covers, some of the saving may be on binding. Comparing 1937 with 1936, it is remarkable to find that the average price per page from every origin, except Germany and Great Britain, has been lowered —by from about 10 per cent in U.S. books to so much as 79 per cent in British Government official publications. But while the British Government has been so greatly reducing its charges, the ordinary British publishers of biological books have been compelled to increase by 16·5 per cent. However, it is possible that the particular books received by the *Quarterly* for review do not represent fair samples in every case; indeed, the total of British Government publications received in all the twelve years only amounts to 8,836 pages, so that, as the authors, Raymond Pearl and Maud DeWitt Pearl, point out, general conclusions must be drawn with caution from this material.

The First Slovakian Polytechnic

IT is true that, for a country of fifteen million inhabitants, Czechoslovakia is well provided with facilities for higher education. There are four universities, one of which is German, and numerous academies and schools of technology that grant recognized diplomas; but until now there has been no Slovak polytechnic. When the new academic year commences in October, however, this will be remedied by the opening of a polytechnic at Košice, in east Slovakia, to be named after Dr. Milan Stefanik, the Slovak astronomer who became the first Czechoslovak Minister for War. This technical institute will rank after the Comenius University of Bratislava as the second most important educational establishment in the eastern half of the Republic. The president, Dr. E. Beneš, has nominated the principal members of the staff, which will include a number of Slovaks who have graduated in science or technology. Their colleagues will be certain lecturers from the Universities and Polytechnics of Prague and Brno, and the new institute will doubtless soon be able to supply local industrial undertakings with students who have obtained their diplomas at Košice.

The Public Health of India

THE vital statistics and public health of India are dealt with in the recently published annual report of the Public Health Commissioner with the Government of India for 1935 (Vol. 1. With Appendixes. Delhi: Manager of Publications. 1937. Rs. 2, or 3*s*. 6*d*.). The mid-year estimated population was 278,199,545, the birth-rate and the death-rate per 1,000 were respectively 35 and 24, and the infantile death-rate per 1,000 live births was 164 (the corresponding rates for England and Wales are 15, 12 and 57). The total mortality from the three principal epidemic diseases—cholera, plague and smallpox—decreased by 24,000 compared with 1934, but this was more than covered by the large reduction in deaths from plague, which fell from 80,000 in 1934 to 32,000 in 1935. Cholera mortality rose to 217,000, the highest figure for the past three years. Smallpox caused 91,000 deaths, as against 84,000 in 1934. Tuberculosis is another disease the incidence of which has increased rapidly during recent years, and which is causing a heavy mortality, particularly in urbanized and industrialized areas. Of fevers, malaria caused the heavy toll of 1,632,000 deaths. No less than 150,000 women died in childbirth or from causes associated with childbirth. An account is also given of the public health services and administration, and of the work of the laboratories and institutes for medical research.

Institution of Electrical Engineers Awards

THE following scholarships have been awarded by the Institution of Electrical Engineers for 1938: *Ferranti Scholarship* (annual value £250; tenable for 2 years): L. S. Piggott (University of Oxford); *Duddell Scholarship* (annual value £150; tenable for 3 years): J. B. Higham (Penarth County School); *Silvanus Thompson Scholarship* (annual value £100, plus tuition fees; tenable for 2 years): H. Darnell (Mersey Railway Company); *Swan Memorial Scholarship* (annual value £120; tenable for 1 year): J. G. Hutton (Sunderland Technical College); *David Hughes Scholarship* (value £100; tenable for 1 year): H. E. Newton (University of Sheffield); *Salomons Scholarship* (value £100; tenable for 1 year): C. Halliday (King's College, Newcastle-on-Tyne). Grants have been made from the War Thanksgiving Education and Research Fund (No. 1) to J. W. Carroll (King's College, London), to E. Franklin (University of Birmingham), and to G. Y. Shute (University

College, Nottingham). Thorrowgood Scholarships have been awarded to C. R. Smith (London & North Eastern Railway), and E. C. Norris (Southern Railway Company).

Indian Cotton

TECHNOLOGICAL CIRCULARS Nos. 323 to 338 issued by the Indian Central Cotton Committee's Technological Laboratory during the first three months of 1938 exemplify very thoroughly the work which is being done in India to improve the cotton crop of the country. Each season early samples of the crops from different parts of the country are sent to the Laboratory for test and each circular summarizes the results obtained in the last six years. No. 336 deals, for example, with a pure line strain isolated in 1931 and grown at the Government Experimental Farm, Akola, where the rainfall is 28 inches per annum, the soil black cotton soil, the growing period from June until November and the maximum temperature varies from 85° to 115° F.; weight of cotton per seed, 30 milligrams, of seed, 62 mgm. 26 seeds per boll, 16 to 18 bolls per plant; yield, 400–800 lb. per acre; 43 thousand acres under cultivation as against 120 acres in 1933. The average length of fibre (staple) is $\frac{7}{8}$ inch, the curve of deviation being approximately the error curve. In manufacture, the percentage of loss from dirt is low, that from carding is normal, about 8 per cent. Fibre strength was best in 1933 and then suitable for yarn of 31 counts, that is, 31 hanks of 480 yards to the pound.

Butterfly Migrations in the Tropics

THE attention of travellers and residents in the tropics is directed to an attractively produced booklet entitled "Butterfly Migrations in the Tropics", recently published by the British Museum (Natural History). It is written on behalf of the Trustees of the Museum by Dr. C. B. Williams, and is well illustrated by means of five three-colour process plates of typical migrant species. The booklet is issued primarily with the object of obtaining information on the subject of migration. Very little is known relative to this problem in the tropics, and it is easy for any accurate and willing observer to assist in this matter. Instructions are given with regard to the special points upon which information is desired. The booklet may be obtained from the British Museum (Natural History), London, S.W.7, price 9*d*.

International Grassland Congress

THE report of the fourth International Grassland Congress held in Great Britain in July 1937 under the presidency of Prof. R. G. Stapledon has now been published. The volume, which consists of 486 pages, contains the full texts of all papers, both plenary and sectional, delivered to the Congress at Aberystwyth. Each is printed in English or German with a summary in the alternative language, the main items of the discussion being also included. The report can be obtained from the Joint Secretaries, Fourth International Grassland Congress, Aberystwyth, for £2, post paid. A smaller volume (pp. 87), containing abstracts in English and German of the majority of the papers delivered, is available for 5*s*. post paid.

Work of the Central Midwives Board

THE report of the Central Midwives Board, recently issued, reviews the work of the Board during the year ended March 31, 1937. The Midwives Roll contained the names of 65,046 women, a net increase of 2,982 on last year's roll. During the year, only 18 midwives were dealt with by the Board under its penal powers on charges of malpraxis, negligence or misconduct, as a result of which seven names were removed from the roll. The Minister of Health approved the revised rules for training and examination, on the preparation of which the Board has been engaged for a considerable time. The two most important changes effected by the new rules are (*a*) an extension of the period of training from 6 to 12 months for State-registered general trained nurses, and from 12 to 24 months for other pupil-midwives, and (*b*) division of the course of training into two parts, each of which will be completed by an appropriate examination. An important decision during the year was the permission given to midwives to administer nitrous oxide and air to women in childbirth, under certain conditions.

Congress of Electroradiology

THE fourth annual Congress of French-speaking Electro-Radiologists will be held in Paris on October 5–8. At the opening meeting, Prof. Joliot-Curie will lecture on neutrons and artificial radio-elements—biological applications and therapeutical hypotheses. The following subjects will also be discussed: the results of radiological methods of examination; the bio-electric phenomena of the nervous system, present state of the question and possible application; anti-inflammatory roentgentherapy; biological action of rays and high-frequency currents; progress of histo-radiography; fresh data on neuro-muscular stimulation; interpretation of electrotoric phenomena. The subscription is 100 francs, which should be sent to Dr. Morel Kahn, 45 rue Scheffer, Paris 16^{e}. Further information can be obtained from Dr. Delherm, 1 rue Loas Cases, Paris 7^{e}.

Studentships and Fellowships in Medical Research

THE Medical Research Council invites applications for a third series of studentships and fellowships intended to encourage young British medical graduates towards becoming investigators in those branches of medical science which are concerned directly with disease as it occurs in human beings. Post-graduate studentships are offered for medical graduates who have already held house appointments and are strongly inclined to a career in clinical science or experimental pathology. Each selected student will receive a stipend at the rate of £200 per annum, during a period not exceeding twelve months, for personal maintenance while undertaking approved courses of study in Great Britain such as may be

regarded as best calculated to advance the student's training in methods of research. The Council also offers research fellowships for candidates of similar qualifications who have already had some experience in the use of research methods. Each fellowship will be tenable for one year at the ordinary value of £250 per annum, and will be renewable in approved instances at the rate of £300 per annum for a second year. Further information can be obtained from the Secretary, Medical Research Council, 38 Old Queen Street, London, S.W.1.

French Association of Microbiologists

ON the initiative of Profs. Bordet, director of the Pasteur Institute of Belgium, Martin, director of the Pasteur Institute of Paris, and Lisbonne, of the Montpellier faculty of medicine, an association of French-speaking microbiologists was formed at a meeting held in October 1937. The first meeting of the new association will be held in October next on the occasion of the fiftieth year of the foundation of the Pasteur Institute of Paris, with Prof. Martin as president, and Drs. Lépine of the Pasteur Institute of Paris and Paul Bordet of the Pasteur Institute of Brussels as general secretaries. Further information can be obtained from Dr. Lépine, Institut Pasteur, 25 rue du Docteur Roux, Paris 15e.

Announcements

CAPTAIN EYSTON in his motor-car *Thunderbolt* broke the world's land speed record on Bonneville Salt Flats, Utah, on August 27. Over the measured mile, the car averaged 345.49 m.p.h. for both ways; the outward run being 347.49 m.p.h., and the return 343.51 m.p.h. The former record, established also by Captain Eyston in 1937, was 311.42 m.p.h. The *Thunderbolt* has two Rolls-Royce engines, each capable of developing up to 2,350 h.p.

DR. T. H. SANDERSON-WELLS has endowed an annual lectureship at the Middlesex Hospital Medical School on the relations between rheumatism and dietetics.

DR. WILHELM A. P. SCHÜFFNER, director of the Department of Tropical Hygiene at the Royal Colonial Institute of Amsterdam, has been awarded the Gold Medal of Honour by the Hanseatic University of Hamburg.

THE College of Physicians of Philadelphia has awarded the Alvarenga Prize to Dr. Richard E. Shope, of the Rockefeller Institute for Medical Research, Princeton, N.J., for his recent researches on the etiology and epidemiology of influenza.

THE twenty-seventh meeting of the Italian Society for the Advancement of Science will be held at Bologna under the presidency of the rector of the University on September 4–11.

THE twenty-fifth French Congress of Hygiene will be held at the Pasteur Institute, Paris, on October 3–8, when the following subjects will be discussed: the plan of the sanitary equipment of France; diet and public health; insurance and public health. Further information can be obtained from the General Secretary, Dr. X. Leclainche, 18 rue de Tilsitt, Paris 17e.

THE sixth Congress of Physical Re-education organized by the French Society of Specialists in Medical Physical Culture will be held on September 10–12 at the Institute of Physical Education of the University of Paris with Prof. Roussy, rector of the University, as president of honour. It will consist of three sections devoted respectively to science applied to physical education and medical gymnastics, the technique of re-education and social realization. Further information can be obtained from the president of the Society, M. Petat, 11 rue Racine, Montluçon, Allier, France.

THE tenth Congress of the Far Eastern Association of Tropical Medicine, which meets every three years, will be held at Hanoi, Tonkin, on November 24–30, when the following subjects will be discussed: deficiency diseases, water supply, cholera, malaria, plague, tuberculosis, venereal disease, surgery, diseases common to man and animals, parasitology, and materia medica of the Far East. The official languages will be English and French. Further information can be obtained from the Organizing Committee, 6 rue de la Convention, Hanoi.

THE fourth International Conference on Timber Utilization is to be held in Brussels on September 15–17. The subjects to be dealt with include tests on the strength of timber in relation to building regulations, timber and plywood for aeroplanes, shipbuilding, etc., and modern possibilities of the utilization of sawmill waste, and reports on the activities of the Department for Timber Utilization. Further information relating to the Conference can be obtained from the Secretary, Comité International du Bois, 50 rue Neuve, Brussels, Belgium.

MESSRS. ADLARD AND SON, LTD., have issued a useful diary for the academic year 1938–39, copies of which were presented to members of the British Association attending the recent meeting in Cambridge. It includes, against the appropriate dates, notes of the meetings of learned societies, and there is also a table showing the dates of the terms of the universities of the British Isles.

BRITISH DRUG HOUSES, LTD., have issued a descriptive leaflet dealing with synthetic lactoflavine, which they now manufacture. This substance is phosphorylated after ingestion, and then forms the prosthetic group of Warburg's yellow ferment, which probably plays an essential part in oxidations in all body cells. It cannot be synthesized in the body, and forms one constituent of the complex of substances once known as vitamin B.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 439.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Loss of Energy by Fast Particles in Nuclear Collisions

THE energy lost by a moving particle in traversing matter as the result of exciting or disintegrating atomic nuclei depends on the law of force between it and the particles constituting the nucleus, and also in general on the state of motion and of binding of the nuclear particles. However, if the incident particle is fast and the forces are of short range, the average energy loss in nuclear collisions may be shown to be independent of the latter factors, and is the same as it would be if all the nuclear particles were free and isolated. The general reason for this may be seen as follows.

Let us consider a nuclear encounter in which the incident particle, velocity βc, approaches the nucleus within a distance r. The 'time of collision', τ, is then of the order of $r/\xi\beta c$, where $\xi = (1-\beta^2)^{-1/2}$. Strictly speaking, terms of the order of $\lambda/2\pi\beta c$, and $\alpha/\beta c$, where λ is the de Broglie wave-length, and α represents nuclear dimensions, should be added in order to avoid contradictions with the uncertainty principle and to allow for the size of the nucleus. However, these terms make no significant addition and may be left out here. The 'natural period', T, of a nuclear particle is of the order of δ/u, where u denotes its average velocity in the nucleus and δ represents the dimensions of the region to which it is confined (the nuclear cell in Bohr's model, for example). Now if $\tau \gg T$ the conditions are adiabatic, and the energy loss is greatly suppressed by the binding forces. However, if $\tau \ll T$ we have the condition of 'sudden impulse', and the average energy loss is the same as it would be if the nuclear particles were free. The transition from the one condition to the other takes place for a value, ρ, of r given by $\tau \sim T$, namely, $\rho = \xi\beta(c/u)\delta$. For the nuclear particles we may take $u/c \sim 1/5$, and for fast incident particles, such as those in cosmic rays, $\beta = 1$, $\xi \gg 1$. Thus $\rho \gg \delta$. Now δ is at least of the order of the range of nuclear forces, σ. Therefore $\rho \gg \sigma$. This means that, as r increases, the interaction with the nuclear particles ceases altogether long before adiabatic conditions set in, that is, before binding forces have any effect on the average energy loss. Inside the range of the interacting forces the conditions are those of a sudden impulse, and the average energy loss is accordingly the same as for a free particle.

This result can also be proved by applying Born's theory of collisions in an analogous manner to its application by Bethe[1] to the excitation and ionization of atoms. The result, however, holds under more general conditions than those which have to be satisfied to justify Born's approximation. The application of the above arguments to the excitation and ionization of atoms leads, under the conditions of Born's approximation, to Bethe's formula for 'stopping power', and to Bohr's classical formula under the alternative conditions. Of course, in the atomic problem the interaction, which is Coulombian, is to be classed as long range, and the binding forces play an essential part in limiting the energy loss.

Assuming the mutual potential energy of a cosmic ray particle and a nuclear particle to be $Ve^{-b/r}$ (and using Born's approximation), the average energy lost by fast particles per centimetre in nuclear collisions, according to the above result, is

$$dT/dx = (4\pi/3)NWV^2b^2/Mv^2,$$

where N is the number of nuclei per c.c., W the number of protons and neutrons in the nucleus, M the mass of a proton (or neutron), and v the velocity of the incident particle, which we may take as the velocity c of light. With $V \sim 40$ M.v., and $b \sim 1{\cdot}0 \times 10^{-13}$ cm., this formula gives an energy loss about one twentieth of that suffered in the usual collisions with the atomic electrons.

The results given here differ from those obtained by Heisenberg[2] in a recent treatment of the problem, though the numerical values are not of a different order of magnitude. Heisenberg calculates the energy loss assuming the nuclear particles to be free, and then assumes that the effect of the nuclear binding forces is to cut out all those collisions which give an energy transfer less than the smallest excitation energy. This procedure is in fact identical with that adopted in a theory of stopping-power given by Henderson[3] before the advent of the new quantum mechanics, and it gives results correct in order of magnitude only. The energy loss calculated by Heisenberg is also greatly increased by his allowance for the initial motion of the nuclear particles in the nucleus. According to my results, this motion does not contribute at all to the average energy loss, though it affects its distribution. The reason for this is that if a free particle with initial momentum p_0 receives in a collision momentum p, at an angle θ with p_0, the energy it acquires is proportional to $p^2 + 2pp_0\cos\theta$, which on the average is equal to p^2 and is independent of p_0.

A more detailed discussion of the points mentioned in this note will be given elsewhere.

E. J. WILLIAMS.

George Holt Physics Laboratory,
University of Liverpool.
Aug. 5.

[1] *Ann. der Phys.*, **5**, 325 (1930).
[2] Leipzig, Akad. der Wissen., **89**, 369 (1937); *Naturwiss.*, **25**, 749 (1937).
[3] *Phil. Mag.*, **46**, 680 (1922).

Anomaly in the Apparent Absorption of Slow Neutrons by Iodine and Boron

IN the course of some experiments on the absorption in boron of the slow neutrons (excluding those of thermal energy) which activate an iodine detector, a rather peculiar phenomenon has been noticed.

It has been found that the absorption coefficient of these neutrons in boron remains apparently constant, even when some 85 per cent of the original intensity has been absorbed. If, however, some 50 per cent is absorbed in an iodine filter, the boron absorption coefficient of the residual neutrons has decreased to a very marked extent. This last effect

has also been found by Ruben and Libby[1]. The exact figures obtained are contained in the accompanying table. The errors given are probable errors and not standard deviations.

Thickness of filter	Fraction transmitted through filter	Fraction transmitted through boron absorber	Absorption coefficient
0	1	0·60 ±0·02	0·77 ±0·07
B 0·96 gm./cm.²	0·25	0·57 ±0·04	0·83 ±0·12
I 0·5 "	0·5	0·75 ±0·04	0·38 ±0·1
I 1·2 "	0·25	0·84 ±0·05	0·2 ±0·1

The first and second columns give respectively the thickness of filter used and the fraction of the intensity transmitted by them, B representing a boron filter and I an iodine one. The last two columns give data for the absorption in boron of the beam of neutrons emerging from the filter. They give respectively the fraction of the intensity transmitted through a boron absorber of 0·30 gm./cm.², and the absorption coefficient deduced from this fraction (not corrected for scattering).

These results show that whereas from the boron absorptions one can say that at least 85 per cent of the activity is due to neutrons having a uniform absorption coefficient of 0·77, the iodine filtration experiment shows that some 50 per cent of the neutrons have an absorption coefficient of almost half this, 0·38.

It has also been found that when both an iodine and a boron filter are used simultaneously, the activity produced in the detector depends on the order in which the filters are placed. The ratio of the activity produced when the boron filter (0·77 gm./cm.²) was followed by the iodine filter (0·84 gm./cm.²) to that produced when the iodine filter preceded the boron filter is 0·78 ± 0·03.

The first experiment has been repeated using a bromine detector in place of the iodine as the absorption regions of these elements overlap to some extent[2], but no change was observed in the boron absorption coefficient of the neutrons on passage through the iodine filter. Nor was any effect observed when an arsenic filter and an arsenic detector were used instead of iodine in this experiment, although iodine and arsenic detectors show nearly equal boron absorption coefficients for slow neutrons[3,4].

In all these experiments, the source of slow neutrons used was a (Rn + Be) source placed at the centre of a wax cube of side 10 cm. The sides of the cube were screened with cadmium sheets, and the absorbers and detectors were placed against the sides of the cube.

The results of these experiments do not seem to be at all explicable unless it is assumed that the passage through one or the other of the filters has resulted in a change in energy of a considerable fraction of the neutrons detected. The results could be interpreted as being due to slowing down of the higher energy neutrons by boron into the iodine resonance region. Alternatively, the effect could be due to an increase in energy of some of the neutrons on passage through the iodine, this latter being possible if some of the iodine nuclei exist in a metastable state of long life.

Further experiments are in progress, however, and a fuller account will be published elsewhere.

J. L. MICHIELS.

Imperial College of Science and Technology,
London, S.W.7.
July 20.

[1] Ruben and Libby, *Phys. Rev.*, **51**, 774 (1937).
[2] Amaldi and Fermi, *Ric. Scient.*, vi-II, 344 (1935).
[3] Goldsmith and Rasetti, *Phys. Rev.*, **50**, 328 (1936).
[4] Frish, *Math.-fys. Medd.*, **14**, 12 (1937).

Scattering of Yukawa Particles by Protons

I HAVE computed the electrical interaction between the heavy electrons as introduced by Yukawa[1] and recently discussed by Kemmer, Fröhlich, Stueckelberg and others[2], using the Dirac-Proca[3] equations for particles of spin one. It was thought that such a calculation would furnish polarization effects analogous to, and yet, because of the different spin, different from the effect found by Mott[4] for the scattering of electrons. The method used was the usual Born-Dirac calculus of perturbation.

It was found that in contrast to electrons, Yukawa particles show a polarization effect even in the first approximation. This effect, perhaps not wholly unexpected due to the similarity of the Proca equations with the Maxwell equations, is caused solely by the transversal wave field; it is proportional to the square of the cosine of the angle between the plane of polarization and the plane laid through the primary and the scattered ray. The second approximation also contains polarization terms, but they are of the form similar to those found by Mott in the case of the electron.

A detailed report of the calculations will be published in the *Physical Review*.

OTTO LAPORTE.

University of Michigan,
Ann Arbor, Michigan.
July 12.

[1] Yukawa and collaborators, *Proc. Phys.-Math. Soc. Japan*, **17**, 48 (1935); **19**, 1084 (1937); and **20**, 319 (1938).
[2] Fröhlich, Heitler, Kemmer, *Proc. Roy. Soc.*, A, **166**, 127 and 154, (1938). Stueckelberg, *Helv. phys. Acta*, **11**, 225 and 299 (1938).
[3] Dirac, *Proc. Roy. Soc.*, A, **155**, 447 (1936). Proca, *J. Phys.*, **7**, 347 (1936).
[4] Mott, *Proc. Roy. Soc.*, A, **124**, 425 (1929); **135**, 429 (1932).

Direct Proof of the Effect of Temperature on the Conduction Electrons of a Metal

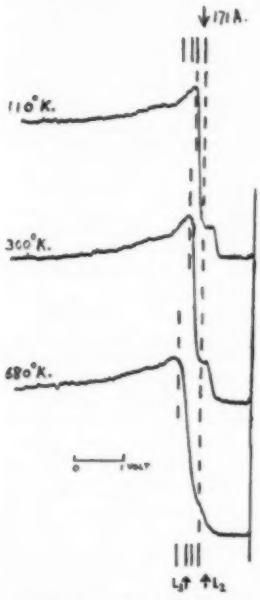
IT has been recognized for some time that the structure of the *K*-, *L*-, etc., emission spectra of the metals in the soft X-ray region (about 10–500 A.) can lead to direct information about the level system occupied by the conduction-electrons[1]. For the radiation of a metal in this region consists wholly (or, in other cases, at least partly) of a band which represents transitions of the conduction-electrons themselves into an inner shell which has been ionized by electron-impact in the X-ray tube; and since the inner level is relatively sharp, the structure of the conduction electron level system is clearly reflected in the emitted radiation. The most characteristic feature is the sharp edge which forms the short wave-length end of such a band; this evidently corresponds to the sharp 'surface' to which the conduction-electrons of the metal fill up the continuum of possible levels. But, theoretically, this surface is only sharp at the absolute zero of temperature. As is well known, the conduction-electrons are subject to Fermi-Dirac statistics and this has the result that at a temperature T, the surface is slightly diffused.

If $N(E)dE$ is the number of levels having energy between E and $E + dE$ and if $N(E)$ is assumed approximately equal to a constant N_0 in a small energy-range near the surface, then the number of *occupied* levels with energies between E and $E + dE$ at a temperature T is given by

$$n(E)dE = \frac{N_0}{1 + e^{\Delta E/kt}}\, dE \quad . \quad . \quad . \quad . \quad (1)$$

where ΔE is measured from the surface at the absolute zero[2].

We have recently been able to show that the edges of the K- and L-bands of metals of the first two groups are sensitive to the temperature of the anticathode of the X-ray tube from which they are emitted. The accompanying photometer curves (six times enlarged from the original plate of the L_{23} band of aluminium at 171 A.) correspond to three anticathode temperatures. The total energy spread of the band is about 15 volts. Owing to the separation of the L_2 and L_3 levels (about 0·4 volt), the edge is actually double. Both components show a marked broadening when the anticathode temperature is changed from that of liquid air (110° K.) to 680° K., and a difference can even be detected for the change from liquid air to room temperature.



The breadth of the edge is partly due to a limitation of the resolution due to the width of the spectroscope slit, which is estimated to correspond to 0·12 volt. If this amount is subtracted from the breadth measured in the way indicated by the lines on the diagram, we obtain a corrected edge-breadth; and the precise manner of measuring this quantity is such that it should correspond to about 6 kT according to equation (1), if the extra broadening is entirely due to this cause. The table below gives the results:

Temp.	Corrected edge-breadth (volts)	6 kT (volts)
110° K.	0·06 ± 0·03	0·057
300° K.	0·17 ± 0·03	0·156
680° K.	0·44 ± 0·05	0·354

It will be seen that, at the two lower temperatures, the breadth of the edge can be entirely accounted for according to equation (1). At the highest temperature, the breadth seems to be a little more than would be expected; the additional amount may be due to the distortion of the lattice by the large amplitude of the heat-motion when the temperature of the aluminium is raised towards its melting point.

H. W. B. SKINNER.

H. H. Wills Physical Laboratory,
University of Bristol.

[1] For example, O'Bryan and Skinner, *Phys. Rev.*, **45**, 370 (1934).
[2] See, for example, Mott and Jones, "Theory of the Properties of Metals and Alloys", 175.

Kramers' Absorption Law in Physical Problems

IN a recent letter to NATURE[1], Dr. T. L. Page reports on an interpretation of the spectrum of hydrogen in the discharge tube and in the planetary nebulæ. The observed data consist of measures of the intensities, in emission, of various members of the Balmer series and of the continuum that lies beyond the Balmer limit. Page states: "In the nebulæ and in the discharge it can be shown that the recombination of protons and electrons must account for almost the entire emission." He interprets the data on the basis of this assumption. All the quanta of Balmer α, for example, he regards as being produced by electrons that have arrived in quantum level 3 either by direct capture in that level or by cascade from higher levels after capture. He apparently neglects all other types of excitation, such as reabsorption of the Lyman line radiation or collision. Failing to find agreement between the number of captures calculated theoretically from Kramers' well-known absorption law and the number deduced from the observations, Page concludes that Kramers' law is in error. I should prefer another alternative, namely, that the nebular and discharge spectra are not entirely due to recombination.

The number of captures in level 2 may be directly calculated from the intensity of the Balmer continuum. The number of captures in level 3 and higher are only indirectly inferred, on the basis of Page's assumption, from the intensities of the Balmer lines. According to Page's tabulation, the observed number of captures on level 3 exceeds those on level 2 by 1000-fold. A crucial experimental test of this result could be made by observing, in laboratory or observatory, the spectrum beyond the Paschen limit. I am confident that the intensity of the Paschen continuum, in either example, will not differ greatly from that of the Balmer. Thus, only a small fraction of the atoms in level 3 have arrived in consequence of capture. The remainder must have arrived by collisional or by radiative excitation. The former process is likely to predominate in the electrodeless discharge. Page does not give the original observational data, but I should expect the intensities to conform rather closely to those arising from a Boltzman distribution at the appropriate temperature.

In the nebulæ, a much better agreement is obtained by applying the full theory developed by Carroll[2] and Cillié[3]. This theory is based on the premise that the nebula is optically thick so that *all* the ultraviolet stellar radiation beyond the Lyman limit is converted, by successive absorption and emission processes, into long-wave and Lyman-α quanta. When the effect of the radiation field is taken into account, the discrepancy practically vanishes. At Harvard Observatory, Mr. James Baker, Mr. Lawrence Aller and I have been preparing a series of papers[4] dealing with the theoretical Balmer decrement under different physical conditions. In Cillié's calculations, the number of discrete hydrogen

levels was limited to fourteen, because transition probabilities were available for only this number[6]. In the Harvard investigations no such limitation was imposed[6].

The following table[7] summarizes some of the Harvard results. The observed data, quoted from Berman[8], have been corrected for the effect of space reddening.

	5000°	40,000°	Obs.	80,000°
Hα ..	2·43	2·71	2·77	2·83
Hβ ..	1·00	1·00	1·00	1·00
H ..	0·53	0·49	0·50	0·48
Hδ ..	0·33	0·29	0·26	0·27
Hε ..	0·223	0·179	0·18	0·169
H ..	0·157	0·120	0·12	0·112
H ..	0·115	0·085	0·09	0·078

The decrement proves to be extremely insensitive to the electron temperatures, indicated at the head of the column. Any temperature between 40,000° and 80,000° will fit the observations satisfactorily. Since the decrement proves to be very sensitive to the radiation field, an even wider range of electron temperatures may be considered. Page[9] has derived a temperature of 1000° from intensity measures of the Balmer continuum. My own independent measures[10] indicate a value at least ten times higher.

In view of the large number of implicit assumptions involved in Page's work, I feel that the outlook for eventually interpreting the nebular and laboratory spectra of hydrogen on the basis of wave mechanics is hopeful. We shall not have to abandon the useful Kramers' formula, in so far as it is compatible with the more precise wave-mechanical expression. Also, since I see no distinction in the present instance between 'astrophysical' and 'physical', I have dropped the qualifying 'astro' from the title of this letter.

DONALD H. MENZEL.

Harvard Observatory,
Cambridge, Mass.
July 11.

[1] Page, NATURE, **141**, 1137 (1938).
[2] Carroll, *Mon. Not. Roy. Astro. Soc.*, **90**, 588 (1930).
[3] Cillié, *ibid.*, **92**, 820 (1932); **96**, 771 (1938).
[4] Series: *Physical Processes in Gaseous Nebulæ*.
Menzel — I Absorption and Emission of Radiation. *Astrophys. J.*, **85**, 330 (1937).
Menzel and Baker — II Theory of the Balmer Decrement, *ibid.*, **86**, 70 (1937).
Baker and Menzel — III The Balmer Decrement, *ibid.* In Press.
Menzel, Aller, and Baker — IV The Mechanistic and Equilibrium Treatment of Nebular Statistics, *ibid.* In Press.
Baker, Menzel, and Aller — V Electron Temperatures, *ibid.* In Press.
[5] Menzel and Pekeris, *Mon. Not. Roy. Astro. Soc.*, **96**, 77 (1935).
[6] In paper III complete transition probabilities up to $n = 35$ are tabulated.
[7] Abbreviated from paper III of reference 4.
[8] Berman, *Mon. Not. Roy. Astro. Soc.*, **96**, 890 (1936).
[9] Page, *ibid.*, **96**, 604 (1936).
[10] Unpublished.

Ultra-Violet Band System of Silicon Monoselenide

As a result of recent observations of band spectra of monoxides, monosulphides, monoselenides, and monotellurides of the group IV(*b*) elements, the spectroscopic investigation of this group of molecules has now reached a stage at which data are available for the ground states and one or more excited states of all the monoxides, all the monosulphides, three of the five monoselenides (namely, CSe[1], SnSe[2] and PbSe[3]) and one of the five monotellurides (namely, PbTe[3]). A recent study[3] of the related band systems enabled the character and approximate position of the corresponding system of SiSe to be predicted.

It was observed[3] that the ultra-violet system of SiS is well developed in a heavy-current discharge through Al_2S_3 vapour in a silica tube. An analogous method has now been successfully employed to develop the corresponding system of SiSe. In a 2·5-amp. discharge through a silica tube containing aluminium selenide a system of some 30 bands degraded to the red has been observed in the region λ 2914–λ 3671, the $0 \rightarrow 0$ band being at λ 3089·3 and comparatively weak. The heads are approximately represented by

$$\nu_{head} = 32{,}448{\cdot}7 + (404{\cdot}3\,u'^2 - 3{\cdot}24\,u'^3) - (580{\cdot}0\,u'' - 1{\cdot}78\,u''^2),$$

where $u = v + \frac{1}{2}$. There can be no doubt that the system is emitted by SiSe formed by the interaction of aluminium selenide and silica at the high temperature (*c.* 1,000° C.) of the positive-column tube.

The ratios of coefficients discussed in connexion with SiS[3] have values of the order of magnitude expected. Thus $I_M I_X / E_e = 19{\cdot}3$, as compared with 19·4 for SiS and 20·8 for SiO, I_M and I_X being the ionization potentials of the atoms, and E_e the electronic energy of the excited molecular state (all in electron volts). Secondly, the ratio $\omega_e'/\omega_e'' = 0{\cdot}697$ for SiSe, as compared with 0·683 and 0·686 for SiS and SiO. Finally, the ratio (ω_e of SiSe)/(ω_e of SiS) has the values 0·790 and 0·774 for the excited and ground states respectively, as compared with 0·778 and 0·873 respectively for (ω_e of CSe)/(ω_e of CS).

Judged by the data for related band systems in this group, the value 3·24 for $x_e'\omega_e'$ in SiSe is surprisingly large; the discrepancy is due to the existence of perturbations in one or more of the excited vibrational levels $v' = 3$, 4 and 5, and the consequent difficulty in evaluating $x_e'\omega_e'$ correctly. With this one exception the coefficients are of the same orders of magnitude as those of the iso-electronic molecule GeS).

Work on the corresponding system of SiTe by an analogous method is in hand.

R. F. BARROW.

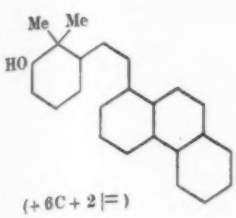
Imperial College,
London, S.W.7.
July 19.

[1] Rosen, B., and Désirant, M., *C.R.*, Paris, **200**, 1659 (1935).
[2] Walker, J. W., Straley, J. W., and Smith, A. W., *Phys. Rev.*, **53**, 140 (1938).
[3] Barrow, R. F., and Jevons, W., NATURE, **141**, 833 (1938); and forthcoming paper.

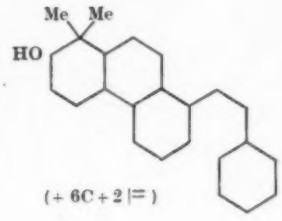
Structure of the Triterpenes

THE tetracyclic triterpene alcohol basseol, which readily cyclizes to give β-amyrenol[1], which in its turn is related to erythrodiol, gypsogenin and hederagenin[2], on dehydrogenation with selenium gives as major product a phenanthrene homologue, m.p. 125° (Found: C, 92·7; H, 7·2. $C_{17}H_{16}$ requires C, 92·7; H, 7·3; $C_{18}H_{18}$ requires C, 92·25; H, 7·75 per cent), characterized as its picrate, m.p. 165° (Found: C, 61·7; 61·8; H, 4·2, 4·3; N, 9·3. $C_{23}H_{19}O_7N_3$ requires C, 61·45; H, 4·3; N, 9·35; $C_{24}H_{21}O_7N_3$ requires C, 62·2; H, 4·6; N, 9·1 per cent). It is apparently identical with the hydrocarbon "$C_{18}H_{18}$" obtained by Ruzicka, Hösli and Ehmann[2] from hederagenin. Our analyses favour a trimethylrather than a tetramethyl-phenanthrene formulation, but the latter cannot be excluded. The hydrocarbon gives a marked depression in melting point on admixture with 1:6:7-trimethylphenanthrene, and

it is not identical with 1 : 2 : 8- or any other known trimethylphenanthrene. The formation of a tri- or (tetra-) methylphenanthrene shows that basseol has one of the partial structures I and II.



(I)



(II)

The structure (III) suggested for basseol by Ruzicka and Schellenberg[3] cannot be correct, as this would require the formation of 1 : 6-dimethylphenanthrene on dehydrogenation.

The identification of the dehydrogenation product, which will have a considerable bearing upon the structure of the oleanolic acid group, is now in progress.

J. H. BEYNON.
I. M. HEILBRON.
F. S. SPRING.

University,
Manchester.
July 29.

[1] Beynon, Heilbron and Spring, *J. Chem. Soc.*, 989 (1937).
[2] Ruzicka and Schellenberg, *Helv. chim. Acta*, **20**, 1553 (1937).
[3] Ruzicka, Hösli, and Ehmann, *Helv. chim. Acta*, **17**, 442 (1934).

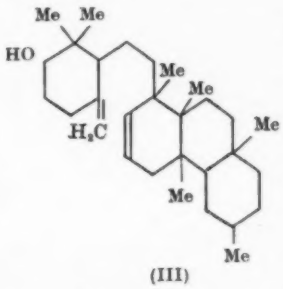
Preparation of 2 : 8-Diamino-Acridine

IT has recently been shown[1] that amino derivatives of acridine combine high antiseptic potency with low toxicity when the orientation of the amino group(s) is other than the 1- (that is, 9-) position. Unfortunately, the general synthetic methods available for preparing specific amino-acridines involve many stages and are usually wasteful of both time and material[2], so that a general reaction for converting simple aromatic compounds to amino-acridines in a single operation would give valuable assistance in exploring further the chemotherapy of these compounds.

A hint of the possibility of such a general reaction seems to lie in a patent of 1921 (*D.R.P.*, 347,819) in which a mixture of glycerol, zinc chloride, *m*-phenylenediamine and oxalic acid is stated to give, when heated, a 60 per cent yield of 2 : 8-diamino-acridine, the sulphate of which is the widely used antiseptic proflavine. So far, no investigation of this reaction has appeared in the literature, nor does the patent suggest that it has wider applicability.

Accordingly we decided to investigate: (*a*) whether substituted *m*-phenylenediamines would take part in this reaction; (*b*) whether aniline reacted in this way either as such or when variously substituted in the *meta* position; (*c*) what the intermediate steps of the reaction are.

The work has reached a stage where an interim report may be made, and our findings to date are: (*a*) that a variety of substituted *meta* diamines lend themselves admirably to the production of similarly substituted amino-acridines of chemotherapeutic interest, up to 72 per cent yields being obtained compared with 62 per cent yield of proflavine-base which we obtained from unsubstituted *m*-phenylenediamine; (*b*) that *meta* substituted anilines are most reactive when the substituent is (in descending order of activity) NH_2, $N(CH_3)_2$, OH and least active when it is CH_3, Cl, NO_2, SO_3H or COOH (aniline itself does not react); (*c*) that the weight of experimental evidence strongly suggests in the case of *m*-phenylene-diamine that the final intermediate is not a diphenyl-methane derivative (as would be expected from analogy with the condensations of formaldehyde with aromatic amines in the production of dihydroacridines) but 3 : 3′-diamino-N-formyldiphenylamine. The precursor of the latter compound may be either 3 : 3′-diaminodiphenylamine or 3-aminoformanilide, both of which were converted to amino-acridines by this general reaction (in the case of 3-aminoformanilide the oxalic acid was omitted).



(III)

Sections (*a*) and (*c*) of the work are still in active progress and a detailed report will appear later.

ADRIEN ALBERT.
DOROTHY K. LARGE.

Department of Pharmacy,
University,
Sydney.
July 11.

[1] Albert, Francis, Garrod and Linnell, *Brit. J. Exper. Path.*, **19**, 41 (1938); Albert, Dyer and Linnell, *Quart. J. Pharm.*, **10**, 649 (1937).
[2] Cf. Albert and Linnell, *J. Chem. Soc.*, 88, 1614 (1936); 22 (1938).

Effect of Desoxycorticosterone and its Esters

WORK carried out in our laboratories[1] has shown that the output of activity of the male and female sex hormones can be varied almost as desired by suitable esterification. By subcutaneous injection of an oily solution, it can reach quite considerable values; in particular, the effect of a few days' duration with the free hormone can be raised to several months by using the corresponding esters.

An increase in effect in the above sense has not been observed up to the present with progesterone and its derivatives[2]. It therefore seemed of interest to investigate the effect of 21-oxyprogesterone or desoxycorticosterone, the artificially prepared hormone of the adrenal cortex first synthesized by Steiger and Reichstein[3]. It is known that extracts of the adrenals have only a relatively transitory effect so that, as is the case, for example, with insulin, it must be injected very frequently when used for therapeutic purposes. This permits the assumption that the hormone is quickly degraded in the organism. In order to solve this problem, we are occupied in preparing and investigating, in addition to the already known acetate, a series of other esters of

desoxycorticosterone. The accompanying table gives some preliminary results:

	Melting point	Average duration of effect in days with a single injection of	
		10 mgm.	20 mgm.
Desoxycorticosterone	141 - 142°	9	—
,, -acetate	157 - 159°	10	12
,, -propionate	163 - 164°	11	—
,, -n-butyrate	110 - 111°	—	20
,, -n-valerianate	84 - 85°	13	—
,, -palmitate	60 - 61°	25	—
,, -benzoate	209 - 210°	20	—
,, -acetate + 100 mgm. palmitic acid		14	—

Control animals: average time of survival 6·5 days.

According to the usual test method, the cortical hormone is injected *daily* or even more frequently; we gave to adrenalectomized young rats, immediately after the operation, a *single* injection of 10 mgm. and 20 mgm. respectively of the substance to be tested; the substance was injected subcutaneously in 2 c.c. of sesame oil and the period of survival ascertained. The figures given in the above table correspond to the average values obtained on from 5 to 13 animals per preparation. The relatively transitory effect of the free hormone and the slight difference in the period of survival compared with that of the control animals is shown by the table. Although with the lower fatty acid esters the average duration of effect is only slightly increased, with the palmitate it is raised to more than three weeks. The benzoate is also of particular interest as its duration of effect is almost three weeks.

A similar increase is obtained by adding an activator such as palmitic acid to desoxycorticosterone-acetate and also by converting the desoxycorticosterone ester into an enol derivative. The implantation of crystals according to Parkes'[4] method appears to be of particular value. The duration of effect of the butyrate after implantation of a crystal weighing 10 mgm. was 25 days (4 animals).

These experiments will be continued in several fields.

In conclusion, it should be mentioned that, tested on the rabbit's uterus, according to the method of Corner and Clauberg, desoxycorticosterone-acetate in doses of less than 10 mgm. shows a progesterone effect.

K. MIESCHER.
W. H. FISCHER.
E. TSCHOPP.

'Ciba' Research Laboratories,
Basle.
July 26.

[1] Miescher, K., Wettstein, A., and Tschopp, E., *Biochem. J.*, **30**, 1970, 1977 (1936); Miescher, K., Fischer, W. H., and Tschopp, E., NATURE, **140**, 726 (1937); Miescher, K., Kägi, H., Scholz, C., Wettstein, A., and Tschopp, E., *Biochem. Z.*, **294**, 39 (1937); Miescher, K., Scholz, C., and Tschopp, E., *Biochem. J.*, **32**, 141, 725 (1938).

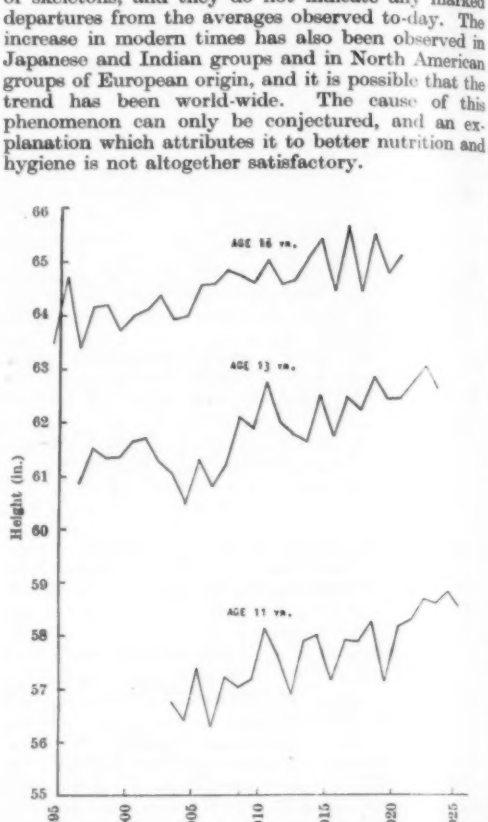
[2] Westphal, U., *Ber.*, **70**, 2128 (1937).

[3] Steiger, M., and Reichstein, T., *Helv. chim. Acta*, **20**, 1164 (1937).

[4] Deanesly, R., and Parkes, A. S., *Chem. and Ind.*, **56**, 447 (1937).

Heights and Weights in a Girls' Public School

THERE is good evidence to show that the average heights of adults have been increasing in several European countries during the past fifty years. Measurements of large numbers of conscripts have been recorded, and for this period they show rates of increase which are not the same in all countries, but are all of the order 1 inch in 25 years. This is an extremely rapid rate, and it is clear that it cannot have been maintained for any long period in the past. The statures of various populations of Europe in prehistoric and early historic times can be estimated from measurements of the long bones of series of skeletons, and they do not indicate any marked departures from the averages observed to-day. The increase in modern times has also been observed in Japanese and Indian groups and in North American groups of European origin, and it is possible that the trend has been world-wide. The cause of this phenomenon can only be conjectured, and an explanation which attributes it to better nutrition and hygiene is not altogether satisfactory.



HEIGHT GRAPH

There exist no reliable data throwing light on secular variations of the average adult statures for British populations. Comparisons of the best figures available are made more difficult owing to the fact that there are clear differences between the means for different social classes. More records obtained in the British Isles are available for children, but the same difficulty is encountered in interpreting them.*

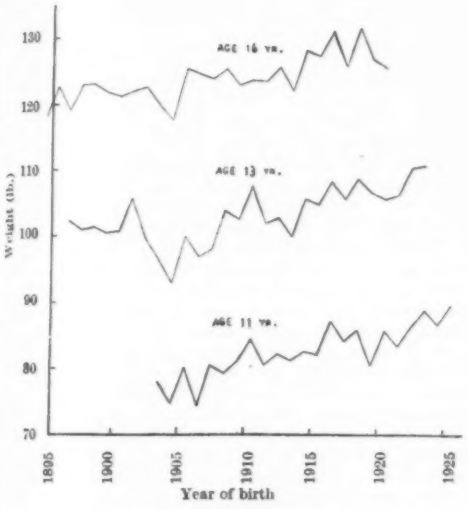
The new measurements here discussed were taken at St. Paul's Girls' School at the annual medical inspections from 1907 until 1937, and were made available by the courtesy of the High Mistress. Of the majority of individuals whose measurements were used, each girl participated at all three ages, so that the data are therefore more homogeneous than is generally the case. If there had been a rise in the

* Miss M. N. Karn has recently collected various records in a "Summary of Results of Investigations into the Height and Weight of Children of the British Working Classes during the last Hundred Years", *Annals of Eugenics*, vol. 7 (1937).

social class represented, this would diminish the significance of the results, but in fact the class-level has remained almost stationary, and has certainly not risen.

The figures were grouped according to year of birth and age last birthday, and the mean heights and weights of each group have been plotted on the accompanying graphs, kindly prepared by Miss Barbara Shuttleworth of Girton College.

The average numbers of measurements in each group for ages eleven, thirteen and sixteen years were 34, 57·6, 63·3, respectively, and no mean is based on fewer than twenty-five measurements. The standard deviations for each series have also been found, and their means for the three ages are 2·682, 2·651, 2·188 in. for the heights and 14·37, 17·30, 15·09 lb. for the weights.



WEIGHT GRAPH

These preliminary results show that there is a marked tendency for girls born in later years to be both taller and heavier than their predecessors, but it should be realized that evidence of a secular change in averages for immature individuals does not prove that there was a concomitant change in the averages for adults, as the former might be due to a quickening rate of growth. As the number of girls measured in any particular year was not large, the fluctuations shown on the graphs are not surprising. A glance suggests that for both height and weight the secular increase was greatest for the girls aged eleven and least for those aged sixteen. Both sets of measurements show a fairly steady increase with time, and there is no sign of a decline in the later years, or of an arrest of the movement in the case of the girls born during the Great War, although the drop for those measured towards the end of the War and immediately after (most noticeable at age thirteen) may be a reflection of war-time conditions at an age at which development normally proceeds rapidly.

On the assumption that the graphs for larger numbers would be close to the best fitting straight lines to the points provided by the samples available, it may be said that for the whole period the average height of girls aged eleven was increasing at the rate of about 1 in. in ten years, that of girls aged thirteen at the rate of about 0·7 in. and that of girls aged sixteen at the rate of about 0·6 in. in ten years. In the case of weight, the rates of increase appear to have been approximately 5·5, 4·2, and 3·8 lb., respectively, in ten years.

The data presented show conclusively that the heights and weights of girls at St. Paul's Girls' School have been increasing significantly in the present century. Hence it is impossible to accept the view that a secular change of this kind has been confined to the lower classes of the community. The fact that all grades have participated in it does not favour the theory that increasing bulk is due to improved nutrition.

It is hoped to publish a fuller account of the investigation when it has been completed.

I want to express my sincere thanks to Dr. G. M. Morant of the Galton Laboratory, University College, London, without whose help and encouragement this work would never have been carried through.

RUTH JACOB.

Newnham College,
Cambridge.
June 27.

A Possible Genetic Mechanism in Heterogonic Growth of Limbs of Cattle

IT is well known that the young of most grazing mammals are born with relatively long legs fit to follow their dams. To achieve these proportions limbs must exhibit *positive* heterogony[1], or allometry[2] as in the latest terminology, during fœtal development, and *negative* heterogony after birth[3].

Analysing data from different sources, I investigated the course of post-natal growth of fore-limbs, relative to the growth of the trunk, in the females of six breeds of cattle, differing rather widely in birth, as well as in mature size and proportions. The six breeds are: the Simmentaler and the Grey Hungarian (data by Szabo v. Hangai[4]), the Brown Swiss (data by Engeler[5] and by Carusi[6]), the Holstein and the Jersey (Missouri data[7]), and the Chianina (original data). I found that for all the breeds the growth of fore-limbs, as measured by height at withers, exhibits, throughout the whole or the greater part of post-natal development, simple negative allometry relative to the growth of the trunk (shoulder to ischium).

The differences in size and proportions during post-natal development in five out of six breeds are not at all, or at most very slightly, caused by differences in the *growth constants* α of the allometric equations $y = bx^{\alpha}$, as α shows very close values ranging from 0·74 to 0·78. It is interesting to note that a similar fact has been observed lately by Walton and Hammond in horses[8]. Therefore the breed differences must be caused chiefly by the *initial* absolute values of limb and trunk length at the moment at which growth begins to follow the post-natal allometric law. This moment does not occur after birth; it might occur before or, more likely, at birth.

It seems possible that the genetical differentiation of the five breeds consists less of genes acting directly on post-natal development than of genes determining, during fœtal development, (1) the *time* at which the post-natal allometry begins to act, and (2) the *size* of trunk and limbs at this moment. If this moment

is not very long before birth, the conclusion might be drawn that the size of limbs and of body of the newborn are not negligible factors in the size and proportions in later life.

GUIDO PONTECORVO.

Ispettorato Compartimentale
per l'Agricoltura della Toscana,
Firenze.
July 9.

[1] Huxley, J. S., "Problems of Relative Growth" (London, 1932).
[2] Teissier, G., "Les lois quantitatives de la croissance" (Paris, 1937).
[3] Hammond, J., "Growth and the Development of Mutton Qualities in the Sheep" (Edinburgh, 1932).
[4] Szabo v. Hangai, B., *Zuchtungskunde*, **4**; H. 9 (1929).
[5] Engeler, W., "Untersuchungen ueber die Entwicklung des schweizerischen Braunviehs" (Bern, 1935).
[6] Carusi, A., *Annali dell' Istituto Zootecnico Sperimentale di Roma*, **2** (1929).
[7] *Missouri Agric. Exp. Stat. Bull.*, **96** (1926).
[8] Walton, A., and Hammond, J., *Proc. Roy. Soc.*, B, **125**, 311 (June 1938).

Geographical Distribution of Zellerielles

REPORTING the occurrence of zellerielles in frogs at Capetown, Sandon[1] reviewed literature on the distribution of the genus geographically and by host families. He contends that the presence of Cape zellerielles is most easily explained on the basis of former land connexions with the other southern continents. Sandon noted that the American and Australian species are confined for the most part to the toothed bufonids and, following Metcalf[2], discounted the Asiatic record of *Zelleriella macronucleata* (Bezzenberger) 1904 from *Bufo melanostictus*. Nie's[3] finding of a zellerielle in *Microhyla ornata* at Nanking, however, establishes it as an Asiatic genus as well. While Wenrich[4] has shown that host specificity of the Opalinidæ is much less rigid than Metcalf supposed, the fact that in Asia (Microhylidæ) and in South Africa (Ranidæ) the host families are not toothed bufonids may be significant. Further, daCunha and Penido[5] have found a *Zelleriella* in a catfish in the Paraguay River, while Carini[6] and Wenrich report others from snakes.

In work on a truncate *Opalina* from *Rana boylii* of California, I have observed in the development of this species a flattened binucleate zellerielle-stage, whereas a cylindrical proto-opaline form is the larval type previously described as characteristic for the genus. This plasticity of form in development within the multinucleate genus *Opalina* suggests that the geographical occurrence of *Zelleriella* and the diversity of its hosts may be explained by the hypothesis that zellerielles have been derived from the cosmopolitan proto-opalines at various times and places.

Sandon's observations on the Ranids included the statement that only one species has penetrated to North America; the Wrights[7] list twenty-four species and subspecies of *Rana* for the United States.

J. L. MOHR.

University of California,
Berkeley.
July 12.

[1] Sandon, H., NATURE, **141**, 1143 (1938).
[2] Metcalf, M. M., "The Opalinid Ciliate Infusorians", *Bull. U.S. Nat. Mus.*, **120** (1923).
[3] Nie, Dashu, *Contrib. Biol. Lab., Sci. Soc. China*, **11**, 67 (1935).
[4] Wenrich, D. H., *Proc. Amer. Phil. Soc.*, **75**, 605 (1935).
[5] daCunha and Penido, *C.R. Soc. Biol.*, **95**, 1003 (1926).
[6] Carini, A., *C.R. Soc. Biol.*, **112**, 400 (1933).
[7] Wright and Wright, "Handbook of Frogs and Toads" (Ithaca, 1933).

Antarctica and Glacial Ages

IN his interesting article on "Antarctica and Glacial Ages"[1], Prof. MacBride states: "If we add the breadth of the ice-shelf to the length of the Beardmore Glacier, we arrive at a total extent of ice-floe of about five hundred miles, and this is considerably longer than any glacier the existence of which we have evidence in the Pleistocene Glacial Age." But, as is well known, rocks of Scandinavian origin are found in the Pleistocene glacial tills of the north-east coast of Norfolk, and there seems very good reason to believe that these erratics were brought into East Anglia by ice originating in Scandinavia. Thus this Pleistocene ice-flow cannot have been much less than 500 miles long, and may have been considerably more. Again, on p. 98, Prof. MacBride claims—after enumerating the Penckian glaciations, that "The most interesting thing about these periods is that the bones and tools of the oldest indubitably human race are found in the inter-glacial interval between the Würm and the Reiss periods". Further, on p. 99, he mentions "the interglacial period between the Reiss and the Würm glaciations—the time indeed when Neanderthal man flourished". I imagine that Prof. MacBride is referring to the inter-glacial epoch (whether it is correctly assigned to that of the Reiss–Würm is another matter) when Late Acheulean man existed, and at the close of which the Neanderthal people lived in Western Europe and made the classic Mousterian implements. Is it to these races and implements that Prof. MacBride would confine the term "indubitably human"?

It is well perhaps to remember in this regard that Neanderthal man was, to say the least of it, a very peculiar, and, in several ways, simian being in his physical make-up, while, more ancient in time than the Late Acheulean and Mousterian implements, are those of Lower Acheulean and Chellean times. It is probable that the Lower Acheulean specimens date back to the inter-glacial phase preceding that mentioned by Prof. MacBride, while the Chellean artefacts are located in the deposits of the still earlier warm period—the Günz–Mindel. As both the Chellean and Lower Acheulean hand-axes exhibit a skill in flaking equal to if not exceeding that of the Mousterian implements, surely the former specimens are entitled to be classed as of the "indubitably human" standard.

As to whether "the drift into high latitudes affords a complete explanation of all glacial phenomena previous to the Pleistocene", I cannot express an opinion. But if this drift does at last provide a complete explanation of any glacial phenomena, it will be hailed with joy by all those who are making a study of these problems. For, up to the present, their explanation has been sadly lacking in completeness.

J. REID MOIR.

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One House Lane,
Ipswich.

[1] NATURE, **142**, 97–99 (July 16, 1938).

I THANK Mr. Reid Moir for his valuable criticisms of my article "Antarctica and Glacial Ages". I shall reply as briefly as possible to the two points which he raises.

First, as to the size of the Pleistocene Scandinavian ice-sheets, I am well aware that these sheets extended

across the North Sea and that their terminal moraines form the "cliffs" of Cromer and the neighbourhood. I paid two visits to Norway and in the course of the first I dredged extensively at the mouth of the Hardanger fiord and climbed to the crest of the Folgefond snowdrift 5000 ft. above the sea. The distance from Stavanger to Hull is about 400 miles and the origin of the Scandinavian ice-flow was close to the coast where the highest ground is found. But the case I put for Antarctica only included the part of it opposite South America which was explored by the Grahamstown expedition, and the highest points from which that flow originated were only 200 miles from the coast. But as the diameter of Antarctica is 1,500 miles—their distance from the opposite coast must be at least 1,200 miles! Further, since Antarctica is 7,000,000 square miles in area and the whole of it is covered by one gigantic ice-sheet, it is safe to say that there is no evidence that any Pleistocene ice-sheet attained anything like these dimensions.

The second point which Mr. Reid Moir raises is the presumed age of Neanderthal (*alias* Mousterian) man. I placed him in the Reiss–Würm interglacial interval. I did so because there are no undoubted human remains from any earlier horizon. The terms Chellean and Acheulean are based not on remains but on stone tools, and I am heretic enough to doubt whether the differences between these tool-types represent anything more than slight changes in the same culture. If we had corresponding remains I have no doubt that Chellean bones would be essentially similar to the Neanderthal type. But if the Chellean tools can really be placed in the Mindel-Reiss interglacial interval, I am most ready to stand corrected. That the first appearance of man belonged to a somewhat earlier horizon in the glacial epoch than I had imagined would make no difference to my argument.

E. W. MACBRIDE.

West Bank,
Alton, Hants.

Pelagohydra mirabilis Dendy in New Zealand

DENDY[1] found a single specimen of *Pelagohydra mirabilis* late in 1901 on the beach at Sumner, near Christchurch. The description gives no location of the material after it was finally deposited, but apparently the work was carried out at Owens College, Manchester.

A further specimen came into my hands, collected by one of my students, on April 11, 1929, and is now in the Canterbury Museum, Christchurch. It was found on Sumner Beach in very similar circumstances to those described by Dendy.

E. PERCIVAL.

Canterbury University College,
Christchurch, N.Z.
April 11.

[1] Dendy, A., "On a Free-Swimming Hydroid", *Q.J.M.S.*, **48** (1903).

Points from Foregoing Letters

BY applying Born's theory of collisions, and also by an independent method, Dr. E. J. Williams estimates that the energy lost by fast-moving particles in nuclear collisions when traversing matter, is the same as it would be if the nuclear particles were free and isolated.

Experiments by J. L. Michiels with slow neutrons show that they are anomalously absorbed in boron and iodine filters, and that the activity produced in the detector depends on the order in which the filters are placed. The results seem to indicate either a slowing down of the higher energy neutrons by the boron into the iodine resonance region, or an increase in the energy of some of the neutrons on passage through iodine.

Photometric curves of the X-ray spectra of aluminium at different temperatures (110°, 300° and 680° K.) are submitted by Dr. H. W. B. Skinner, showing changes in the breadth of the edge of the L_{23} band at 171 A. The change between the lower temperatures can be explained by the heat effect upon the conduction-electrons, but the broadening at the higher temperature seems to imply a distortion of the lattice near the melting point.

Dr. D. H. Menzel points out an alternative interpretation of T. L. Page's conclusions in connexion with nebular and laboratory spectra of hydrogen, which does not invalidate Kramers' absorption law.

R. F. Barrow reports the observation and vibrational analysis of the ultra-violet band system of SiSe corresponding to that of SiS recently described by him and Dr. W. Jevons.

Further steps in the elucidation of the chemical structure of basseol, a triterpene alcohol, are reported by J. H. Beynon, Prof. I. M. Heilbron and Dr. F. S. Spring, who submit two possible formulæ.

The reaction by which 2 : 8-diamino-acridine is produced from *meta*-phenylene-diamine in a single operation has been investigated by Dr. Adrien Albert and Miss Dorothy Large and found to be of general application. The course of the reaction is indicated.

The physiological action of desoxycorticosterone (the artificially prepared hormone of the adrenal cortex) upon rats whose adrenal glands had been removed, can be prolonged by using the esterified hormone. The longest effect has been obtained by Dr. K. Miescher, Dr. W. H. Fischer and E. Tschopp by subcutaneous injection of the palmitic acid ester dissolved in sesame oil.

Analysing data from various sources, Dr. G. Pontecorvo finds that in the females of five out of six breeds of cattle, the difference in size and proportion of fore-limbs relatively to the trunk in the various breeds (during post-natal development) are caused chiefly by the absolute values of limbs and trunk at the moment when the growth changes from positive to negative 'allometry', and this occurs either before, or at, birth. The genetical differentiation between breeds, he suggests, may be due to genes acting upon the fœtal rather than the post-natal development.

J. L. Mohr points out that the parasitic zellerielles in frogs are more widely distributed than usually supposed, and that their sporadic geographical occurrence may be explained by the hypothesis that the zellerielles have been derived from the cosmopolitan proto-opalines at various times and places.

Research Items

Pre-Folsom Culture in California

OWING to lack of funds, it has been found necessary to bring to a close the excavations on the stone age site at Borax Lake, California, which were being conducted by an expedition of the Southwest Museum of Los Angeles under Mr. M. R. Harrington. This expedition, as already announced (see NATURE, 141, p. 1004) had discovered stone artefacts at a depth of eight feet below implements of the Folsom type, thought to be contemporary with the Folsom industry found in New Mexico in association with an ice age type of fauna, now extinct. Further investigations at Borax Lake since the first announcement only serve to confirm the initial view of the high antiquity of the implements from the lower series; but the deposits are at too great a depth, and the site too vast, for complete systematic examination with the limited financial resources the museum expedition has at its disposal. This would be possible only if Government assistance were forthcoming through a grant from the Public Works appropriation. In the meantime, it is announced in a statement issued by Science Service of Washington, D.C., certain tentative conclusions have been formed on the basis of this first season's work. Presumably the Folsom people who camped at Borax Lake were of the same type as those of the Folsom sites of New Mexico and Colorado, and were their contemporaries. Before the arrival of the Folsom people, the site was occupied by another race, who lived there for a sufficient length of time to build up an accumulation of more than eight feet of soil mixed with human refuse. The building up of this eight feet of soil and refuse gives a minimum period of time for the oldest occupation, as the level of the Folsom culture, on the surface or near it, may have been lowered by erosion, whether by wind or by water, as is known to have happened in some of the sites examined, for example, in New Mexico. Much further work on the stratification is needed before these conclusions can be regarded as in any way final.

Iodides as Antidotes in Thallium Poisoning

IN the course of some investigations at the Brno Veterinary School upon the action of thallium acetate on rats, Prof. O. V. Hykeš and Dr. F. A. Diakov have found that iodides administered subcutaneously greatly reduce the toxic and other effects of thallium (*Biologické Spisy Vysoké Školy Zvěrolékařské*, 15, pp. 29–45). Six groups of rats were dieted for 32 days with an addition of 0·3 mgm. of thallium acetate and then for 6 days with 0·4 mgm. per hundred grams of body weight. Four of the groups were given daily injections of 0·5 c.c. of solutions of the iodides of lithium, potassium, sodium, and magnesium containing 20 mgm. iodine per c.c., respectively. Animals of the fifth group were treated with calcium iodide, but they soon showed signs of dermatitis due to the calcium, and they were afterwards given injections of sodium iodide. The sixth group, serving as a control, were given the thallium acetate with their diet but without the iodide injections. They quickly developed symptoms of acute thallium poisoning, and the acetate had to be omitted periodically from their diet. A seventh control group received no chemical treatment and the animals grew normally, the females having litters. All the animals treated with lithium, potassium or sodium iodide looked healthy, and increased in weight and preserved their coats. Rats injected with magnesium iodide looked healthy, but had lost much hair. Those of the sixth group had lost almost all hair and even the feelers were affected. After 35–40 days they developed eye cataracts; but no indication of this was observed with animals subjected to iodide injection. Administration of iodides is thus shown to reduce very considerably the toxicity and loss of hair due to thallium salts, and the authors conclude that this antidotal effect is brought about in a physico-chemical manner. It would appear that the action of thallium acetate is direct and does not pass through the endocrine or endocrine sympathetic system.

Phyllopod Crustacea

PAUL MATHIAS has published a most useful general memoir entitled "Phyllopoda: Biologie des Crustacés phyllopodes" (Actualités scientifiques et industrielles, 447. Paris: Hermann et Cie. 1937). This is a good account of the group by one who has worked at it to a considerable extent. All interested in these small Crustacea should possess it. General characters, conditions of life, movement, respiration, alimentation, reproduction, eggs, growth and duration of life, regeneration, enemies, uses, distribution both recent and fossil, all have their fair share of attention. This is an ancient group, and some of the oldest fossils known show a structure very similar to recent forms. The earliest Phyllopods are found in marine deposits, but from Cambrian times freshwater forms are well characterized. The author draws largely on his individual store of knowledge, especially in experimental work, making the essay specially valuable. There is a good and full bibliography.

Greenkeeping Research

THE latest issue of the *Journal of the Board of Greenkeeping Research* (5, No. 18; 1938. 3*s*. 6*d*.) contains an article on the effects of sulphur in improving the physical condition of clay soils. Results from experiments suggest that surface application of sulphur increases the porosity of heavy soil, but readers are recommended to approach the St. Ives Research Station, Bingley, Yorks, for advice before making trials themselves. Although compost sterilization to destroy weed seeds, eelworm, etc., has been used for some years, more efficient methods are always being sought, and an article in this number of the *Journal* describes the latest steaming and electric plants designed for this purpose. Interesting accounts are also given of the problems of greenkeeping research in New Zealand and the differences between greenkeeping conditions in the United States and Great Britain. Particulars are supplied of the third course of instruction for greenkeepers which it is proposed to hold in the autumn provided the demand is sufficient, and attention directed to the fact that the principal makes of mower and other implements may be inspected at the Permanent Implement Exhibition at the Station.

'Stripe' Disease of Narcissus

AT a meeting on August 22 of Section K (Botany) of the British Association, Dr. J. Caldwell discussed certain aspects of this disease. The disease has been recognized by growers and others for a very long time, and there is evidence that it is spreading rapidly in the field. In some instances in commercial stocks every plant has been found to be infected. It must be noted, however, that some varieties show a high degree of tolerance to the disease, even though they are highly susceptible. The varietal response to the disease differs markedly, and while the symptom-complexes can be grouped into various categories, it is not possible as yet to determine beforehand which types of symptoms are to be expected in any new variety. The symptoms found in plants infected with 'stripe' fall into three main groups: (*a*) a more or less simple mosaic characterized by the appearance of small chlorotic areas on the leaves and flower-stalks of the plants, with some 'break' in the petals and coronas of varieties with coloured flowers; (*b*) severe mosaics characterized by the occurrence of large highly chlorotic areas on the leaves; and (*c*) proliferation and overgrowth of tissue on the leaves and flower-stalks as in Czarina and Weardale Perfection. There is probably a fourth group in which there is marked distortion in the plants; but it is not yet clear how far this differs fundamentally from the symptoms in group (*c*). The examination of a very large number of wild species of *Narcissus* growing under natural conditions has so far yielded no evidence that any of these symptoms are found in the wild *Narcissus* (*N. Pseudo-Narcissus*). There is no evidence that the disease is seed-borne in the cultivated varieties. No vector has yet been found by any of the investigators of the disease, and there is little detailed published evidence that the disease is experimentally transmissible. It has been found that the juice of infected bulbs is infective after passage through Pasteur-Chamberland *L*3 candles and that the agent reacts in a manner typical of a virus. The method of inoculation found to be most effective was by hypodermic needle with subsequent damage to the leaf tissue at the base of the leaves. In the main, inoculations made in the early part of the season are more effective than those made later. The histological changes in the tissues associated with the disease are also considered.

Curvature of Columnar Jointing in Volcanic Necks

THE mechanics of the columnar jointing of basaltic lava is already well understood. C. B. Hunt has now attempted to explain the characteristic curving of such joints in volcanic necks (*Amer. J. Sci.*, **142**; 1938). The joints that first form are at the surface and stand in a vertical position. The heat loss in a vertical direction from a pipe diminishes with depth, whereas the heat loss laterally diminishes inwards from the sides. From an analysis of the contraction stress ratios and of the incipient fractures dependent on the variable rates of cooling, it is found that the fractures progressively change from a practically vertical position at the top to a practically horizontal position in depth. At any given point, fracturing may be along either of two sets of planes, one dipping outward towards the sides of the pipe, the other dipping inward. The set dipping outward is favoured by cracks extending downward from the surface, because contraction is greater towards the sides than towards the middle of the pipe. The analysis is illustrated by reference to the numerous volcanic necks of the Mount Taylor region of New Mexico. (For a British example, see S. I. Tomkeieff. "The Dolerite Plug at Balley-galley Head, Co. Antrim". *Irish Nat. J.*, July, 1935.)

Chromatographic Separation of *Cis*- and *Trans*-Azobenzene

AN interesting application of chromatographic analysis has been made recently (Zechmeister, Frehden and Jörgensen, *Naturwiss.*, **26**, 495; 1938), the process having been employed for the separation of *cis*- and *trans*-isomerides. G. S. Hartley (NATURE, **140**, 281; 1938) discovered that azobenzene (m.p. 68°) suffered a partial transformation into the *cis*-form (m.p. 71°–72°) on exposure to sunlight. The heterogeneity of the product can readily be shown by chromatography. The solution of the mixture of the *cis*- and *trans*-forms of azobenzene in benzene or benzine is passed through a long tube filled with specially selected aluminium oxide. Benzene is also used as developer. The adsorbent shows two intense yellow zones separated by a broad white layer. After elution with ice-cold ether, the crystalline *cis*-compound was obtained, the properties of which were identical with those of the compound described by Hartley. The absorption affinity of the *cis*-isomeride is considerably greater than that of the *trans*-form. It would be possible to use the method to discover whether the spontaneous isomerization of lycopene (Zechmeister and Tuzson, NATURE, **141**, 249; 1938) is a *cis-trans*-isomerization.

Inclination of Spiral Nebulæ to the Line of Sight

IN January 1938, Mr. F. G. Brown published a paper in which he showed from his calculations of the inclinations to the line of sight of the planes of the extra-galactic nebulæ of more than 2′ in diameter in Reinmuth's catalogue that the preponderance of small inclinations could not be accounted for by observational selection, but was apparently due to a systematic orientation of the planes in space (*Mon. Not. Roy. Astro. Soc.*, **98**, 3; 1938). A notice of this paper appeared in NATURE of April 30, p. 796. Dr. H. Knox-Shaw considers Mr. Brown's conclusions are so inherently improbable that he felt it worth while to investigate the matter further (*Mon. Not. Roy. Astro. Soc.*, **98**, 7; May 1938). He has made a calculation similar to that of Mr. Brown, using the objects in the Shapley-Ames catalogue given in the *Harvard Annals* (**88**, 2; 1932), but adopting the revised dimensions and descriptions for 448 of the nebulæ given in Part 4 of the same volume of the *Harvard Annals*. As this catalogue covers the whole sky and the dimensions of the nebulæ contained therein are taken from a number of sources, it affords the best material for testing the matter under discussion. The Heidelberg catalogue used by Brown goes down to declination −20° only, and for this reason probably contains a larger proportion of nebulæ from the polar cap than the Harvard catalogue, which shows that about one third of its objects are within 30° of the north galactic pole. The elongated spirals are a little more frequent in this region than elsewhere, and the large proportion of elongated objects found by Brown may be due to the preponderating influence of the rich polar cap. In any event, the difference between the results from the two catalogues suggests that selection has an important effect on the figures obtained, and the planes of the spirals are probably distributed in a random manner, contrary to the view advocated by Brown.

The Mathematics of Experimentation

THE first morning of the British Association meeting at Cambridge saw a discussion in Section A* (Mathematics), of exceptionally wide interest to workers in experimental science. The five speakers, three American and two English, had all in recent years engaged in the study of the combinatorial problems underlying modern types of experimental design, aimed at eliminating errors due to heterogeneity of material, and at founding inferences on valid tests of significance.

On one side, the experimental importance of designs such as the Latin square, now widely adopted, has led mathematicians to a more serious study of old problems of which the previous treatment in the mathematical literature has been discontinuous and desultory; on the other, fresh combinatorial possibilities are being explored, capable of meeting the peculiar experimental difficulties encountered in fields at present ill supplied with effective experimental designs.

Prof. C. C. Craig, of Ann Arbor, Michigan, opened the discussion with an account of tests of significance from which the customary basis of the theory of errors, the normality of residual deviations, is completely eliminated. Such tests, using the ancillary information supplied by the data themselves, have been the subject of several recent mathematical papers. Their logical cogency is unquestionable; but their use is limited by their being certainly laborious, and usually believed to be less sensitive than the simpler tests in common use. Prof. Craig exhibited a theoretical approach to the problem of sensitivity, and showed that this is more nearly comparable than is often supposed with that of the ordinary tests based on the theory of errors.

In discussing the enumeration of the Latin and Græco-Latin squares of side 7, Dr. Horace W. Norton, of the Galton Laboratory, London, gave a most interesting account of the transformation sets into which these can be grouped. As has long been recognized, an aggregate of $7! \times 6!$ (3,628,800) Latin square solutions may be represented by a single standard square, having the letters of the first row and column in standard order. By the process of intramutation, the six letters other than the corner element, *A*, are permuted, and the rows and columns rearranged to the standard order. Thereby sets up to 720 standard squares may be generated, such sets having an invariant diagonal structure, by which possible identifications can be recognized. Choice among the 49 possible corner elements then gives a transformation set of possibly 35,780 standard squares. Finally, permutation of the three categories, rows, columns and letters, may yield 6 adjugate sets, or 211,680 standard squares in all. In the less degenerate sets, recognition of possible identities among corner elements, and among categories, is easily accomplished by mapping the positions of the 2×2 Latin squares, of which usually, but not always, there are a number intercalated in any square under investigation. These big sets are sufficiently large to be useful in enumerating the entire family of 7×7 Latin squares, which do not perhaps exceed 25 million in number. The essence of the procedure is that we should be able to test expeditiously whether any given square is a member of a set already known, or whether a new set has been discovered.

The reversal of an intercalated 2×2 square will generate a new square, not usually belonging to the original set. Most of the sets so far known (about 100) have been discovered in this way, and it is not impossible that all sets having intercalates form one connected system. The process cannot, however, lead to any set which lacks intercalates altogether, and Dr. Norton made a fruitful suggestion in pointing out that reversal may also be applied to intercalated 2×3 rectangles, which may lead to such sets. The sets lacking intercalates so far discovered are, however, all involved in Græco-Latin squares, in which the permutation of four categories may generate 24 different adjugate sets having, as Latin squares, four different aspects. The five known Græco-Latin sets all involve in some aspect squares orthogonal to the very degenerate group known as cyclic squares, which, as Jacob had shown, are only 120 in number. The number of Græco solutions of these squares, running into hundreds, contrasts strikingly with the rarity of Græco solutions among the ordinary sets of Latin squares. During the year, Dr. Norton has enumerated about 12 million standard squares, and has incidentally brought to light a structural system of relationship, more important perhaps for our general knowledge of Latin and higher squares, than the simple problem of complete enumeration.

The bearing of such combinatorial researches on practical experimentation was well brought out by the two following speakers, Dr. W. J. Youden, of the Boyce-Thompson Institute, New York, and Mr. Frank Yates, of Rothamsted Experimental Station. Dr. Youden discussed problems confronting the plant physiologist or plant pathologist using as experimental material the successive leaves of a number of different experimental plants. He gave data to explain his experience that both the individuality of the plant and the ordinal value of the leaf very largely affect the reaction observed. Precision is greatly increased if both these factors can be simultaneously eliminated, as in the Latin square. The number of substances or dilutions which it is necessary to test simultaneously, is, however, often greater than the number of leaves on each plant. In such cases, the elimination of plant individuality may be effected by Yates's method of incomplete randomized blocks, in which although all treatments cannot be applied to any one plant, every treatment is tested in the aggregate on the same plants with one or more complete replications of the alternative treatments. In other words, every *pair* of treatments occurs equally frequently on the same plant. Youden showed that this advantage may be combined, as in the Latin square, with having one complete replication at each leaf level.

Those solutions of the problem of incomplete blocks, of which tables have now been published, in which the number of replications is equal to the number of elements in a block, furnish the basis for the formation of Youden's squares. In these the rows and columns are equal in number to the treatments, or to the plants, while the letters are only as numerous as the number of replications, or of leaves

on each plant. Every row and column must contain all letters once, the remaining spaces being unoccupied. Further, every pair of rows (or columns) must be occupied simultaneously in the same number of columns (or rows). When the incomplete block solution is known, little difficulty has been found in completing the square. The non-existence of an incomplete-block solution is, however, a difficult matter to establish, and Dr. Youden indicated that nearly exhaustive trials so far suggested the non-existence of the (arithmetically) possible 22×22 square having seven letters.

It was gratifying to observe that a large and predominantly mathematical audience showed the greatest interest in Dr. Youden's account of practical experimental requirements, and in the variety of applications which the known solutions open up in biological material.

In the short time available, Mr. Yates, whose work in this field is widely known, confined himself to explaining the logical genesis of the very beautiful Lattice square, commencing from the simple, triple or multiple lattice. This whole group of designs is adapted to the requirements of the plant breeder, who may need to test two hundred or more varieties in a single year. If the number of varieties is a perfect square, they may be cross-classified in a square lattice, of which the rows and columns supply the block contents in two contrasted types of replication. The block size is thus reduced to the square root of the number of varieties. In a triple lattice a third type of replication is supplied by choosing for the same block varieties having the same letter of a Latin square, which may always be found. Squares, the side of which is an odd number, or a multiple of 4, will also always yield a fourth type of replication, making a quadruple lattice. For prime numbers, and, as appeared later in the discussion, for all powers of primes, a complete set of mutually orthogonal classifications is possible, leading, if one replication of each type is used, to one of the known solutions of the problem of randomized incomplete blocks. We have, however, free choice in the topographical arrangement of the plots, and if the number of varieties is the square of an odd number, such as 11, we may halve the number of complete replications by superimposing pairs of these in a Latin square, so that six 11×11 squares will suffice to give equal precision to all comparisons. This considerable advantage, combined with the high precision to be expected in Latin square designs, makes the scheme as attractive experimentally as it is mathematically elegant.

Mr. W. L. Stevens, of the Galton Laboratory, had a surprise in store, in the form of a demonstration of the fact that for any power of a prime a completely orthogonal square exists. The converse had been asserted, on the basis of an erroneous proof by Wernicke in 1910, but the theorem had appeared to be probably true from the construction in 1936 of completely orthogonalized squares of sides 8 and 9, by Yates and Fisher respectively. It was known to his associates that Mr. Stevens had already established a demonstration for the square of any prime number, but the very simple generalization which he gave had only occurred to him during the week.

Based on the theorem that if s is a power of a prime, a field of s symbols with the corresponding operations of addition, subtraction, multiplication and division can be defined so that the results of these operations fall within the field and are unique, we may define a Latin square by the equation

$$u_L = u_\lambda u_R + u_C \qquad u_\lambda \neq 0_C$$

where u_R, u_C and u_L designate the row, column and letter of any element, and u_λ is arbitrary apart from the restriction that it may not be zero.

Assigning its $s-1$ possible values to u_λ generates $s-1$ Latin squares, and the uniqueness of the solution of the equations, regarded as simultaneous in u_R and u_C

$$u_i = u_\lambda u_R + u_C,$$
$$u_j = u_\mu u_R + u_C,$$

shows that the element having a given letter i in the first square, and a given letter j in the second, is uniquely determined in row and column. Thus any two Latin squares of the set are orthogonal, and the whole constitutes a completely orthogonalized square.

It was interesting to learn that the 9×9 squares obtained in this way are different from one previously given by Yates, so that for the larger squares a multiplicity of completely orthogonal solutions is to be anticipated.

It is much to be regretted that the programme allowed no time for discussion. We should have liked to hear the reaction of many mathematicians in the audience, which remained to the end closely interested.

R. A. FISHER.

Plant Growth Substances

FOLLOWING a project first put forward in 1925, the Committee on Intellectual Cooperation of the League of Nations and the International Council of Scientific Unions have agreed to collaborate in the calling of occasional conferences on well-defined fields. The first of these, on the plant growth substances, or phytohormones, was held in Paris on October 1–2, 1937, under the joint auspices of the C.I.C. and the International Union of Biological Societies.

The report of the conference,* which has just been issued, contains eight contributed papers and discussion. Prof. Kögl (Utrecht) describes the determination of the chemical nature of auxins *a* and *b* and the isolation of biotin. Dr. Niels Nielsen (Copenhagen) discusses the substances promoting growth in the fungi, and the difficulties introduced by the varying abilities of organisms to synthesize different members of the group of active substances. The evidence associating the formation and action of auxins with oxidative metabolism is reviewed by Prof. Koningsberger (Utrecht), the phenomenon of bud inhibition and other correlations by Prof. Dostál (Brno) and the relation between the phytohormones and plant tropisms by the chairman, Prof. Boysen

* Etudes et Recherches sur les Phytohormones : Première Réunion organisée en collaboration avec l'Union Internationale des Sciences Biologiques, Paris, 1 et 2 Octobre, 1937. Pp. xiv+125. (Paris : Institut International de Coopération Intellectuelle.)

Jensen (Copenhagen). Prof. G. S. Avery (New London, U.S.A.) makes a plea for the consideration of the auxins as protoplasm irritants or 'evocators'. Prof. Bouillenne (Liège) discusses the action of auxins on cell division and root formation, and expresses the rather surprising opinion that although promotion of cambial division and inhibition of lateral bud development occur on applying pure auxins, at concentrations within the physiological range, to a variety of plants, nevertheless "under natural conditions" the auxins do not have these effects. Finally, Mlle. Zollikofer (Zurich) reviews the rather unsatisfactory state of the work on the effect of animal hormones on plant growth. It seems unfortunate that Prof. Němeč, who (according to the preface) proposed the conference, and who has long been active in the closely related field of regeneration, should not have been present.

As is natural in a field which is developing so rapidly, there are many matters of dispute, and most of the papers stress points of uncertainty rather than the well-established facts. The very extensive material presented, however, makes clear how impressive has been the progress in the last few years towards an understanding of the control of growth in plants. Perhaps the most interesting parts of the book are the discussions, which are reported in full. Naturally a conversation between half a dozen men who are really familiar with the field is of much greater value than the usual questions at a large meeting.

The fact that many substances, which are probably not present in plant tissues, have physiological effects almost indistinguishable from those of the naturally occurring auxins, raised much discussion. Animal hormones present parallel cases. The difficulty centred partly on nomenclature, and partly on the applicability of results obtained with these synthetic substances to the interpretation of natural processes. As to the former, an agreement was reached according to which two groups of growth substances are distinguished, (*a*) the auxins, (*b*) the bios group. The auxins comprise those actually present in plants (phytohormones proper), and those not present but exerting similar effects. The bios group includes aneurin, biotin, œstrin, etc., known to be present in plants, and a group of substances designated 'specific nutrients', such as mesoinositol, β-alanine, leucine, and pyruvic and gluconic acids. The grouping of these latter under bios, a term which up to now has had a rather specific meaning, seems wholly unjustified, both because 'specific nutrients' are difficult to define and because such a large and heterogeneous group of compounds is involved.

Another question raised was whether the action of auxins constitutes 'irritability' or not. However, this was soon found to be unprofitable for lack of a clear statement of the rather old-fashioned concept of 'irritability' or stimulus, and the related one of stimulus-substances (*Reizstoffe*).

At the close of the conference, Prof. Boysen Jensen invited the members to meet again in Copenhagen in September 1939. The success of this first venture would seem to justify further extension of these small conferences between specialists in definite fields of scientific activity.

KENNETH V. THIMANN.

Contributions of Engineering to Physics

PROF. M. L. E. OLIPHANT, of the University of Birmingham, took as the subject of his evening discourse to the British Association, delivered at Cambridge on August 22, the contributions of engineers, more especially electrical engineers, to the science of physics. To cover the whole field in a single lecture would be impossible and so he confined himself to a few only of the technical contributions made by electrical engineers to physics. He began by making a quotation from a dinner speech of Lord Rutherford.

"For the greater part of my life I have been engaged in investigations to try to obtain a clearer idea of the relations between electricity and matter, and the all-important part that electrical charges play in the structure of the atoms of our material world. Yet, I would find it difficult to tell you what electricity is. It is so fundamental an entity in Nature that explanation is impossible. Yet our knowledge of the laws which electricity obeys is now so complete that we are able to predict with considerable confidence the performance of any piece of electrical machinery—provided, of course, it is large compared to the atom."

As Prof. Oliphant was a pupil of Lord Rutherford and naturally the inspiration which he gave to all who worked with him in his famous laboratory has coloured his outlook, he wisely contented himself by illustrating his lecture by examples taken from the Cavendish Laboratory and the work carried out there, going back to the time when sealing-wax and string were practically the only essentials of a piece of apparatus for physical research. Many physicists regret the passing of that direct simplicity of approach. They recognize that the physicist can no longer be self-sufficient. The time is therefore ripe for a review of the situation which may help us to see how the interactions of engineering and physics may best be employed to their mutual advancement.

Electrical engineering, by the provision of technical equipment and facilities and by nurturing physical research in its own laboratories, has made the greatest contribution to the advancement of physics. Prof. Oliphant pointed out that when Faraday in 1831 made fundamental experiments on the magnetic induction in an iron ring, he had to make his own insulated conductors by winding laboriously twine and wire together over layers of calico.

Probably the greatest contribution made by electrical engineering to the physical sciences is the provision of an abundant and steady supply of electricity for laboratory purposes. Prof. Oliphant recalled the time when a small gas engine used to drive a dynamo, and this in turn was used to charge accumulators. The supply of electricity to a class was therefore limited, and the voltage drop made the experiments very difficult. Rutherford used to tell of the trouble of preparing each morning a number of Grove cells and how these used often to fail badly in the course of the day's work. In these days also, the only voltmeter in the Cavendish Laboratory was a Cardew hot-wire instrument which was very sluggish in its action and took a large current, so that in measuring the voltage of a small accumulator, great care had to be taken

to prevent the accumulator being run down completely. Nowadays, ammeters and voltmeters of precision are available at low prices for laboratory work. This is due to the great demand for them by the wireless industry.

When electricians agreed to make alternating current supply the standard, many laboratories found themselves in considerable difficulties, as a steady direct current is needed for many fundamental experiments. Luckily, the copper-oxide rectifier developed by the Westinghouse Company in the United States 'converts' the alternating current into direct current most satisfactorily. These efficient and apparently everlasting little pieces of apparatus have saved physical laboratories large sums of money and have proved of immense help. The copper-oxide rectifier when exposed to light is found to generate an electric current. It is therefore possible to use it in photometry and for measuring the density of photographic blackening.

Prof. Oliphant pointed out how the work of Cockcroft, Lawrence and Kapitza has revolutionized the apparatus required for a physical laboratory. With the help of the Metropolitan-Vickers Electrical Co., Ltd., a 50-cycle 2,000 kw. A.C. generator has been constructed the nominal rating of which is 2,000 kw., but when short-circuited for half a cycle develops a power of 55,000 kw. Magnetic fields were generated of considerable volume under a magnetic force of 300,000 gauss. Dr. T. E. Allibone's valuable work on the problem of applying high electric potentials to evacuate insulating vessels is of great importance. Before he left the Cavendish Laboratory he had succeeded in producing considerable beams of artificial β-rays.

Dr. C. R. Burch, of Metropolitan-Vickers, found that it is possible to produce by vacuum distillation of mineral oils, residual oils with very low vapour pressure. These oils can be distilled unchanged in a vacuum of a fraction of a millimetre. The apparatus of Cockcroft and Walton was an unqualified success and with it they showed for the first time that accelerated particles of hydrogen can penetrate the nucleus of certain atoms and produce profound changes in them. This and the discovery of the neutron stimulated research into these problems all over the world.

At the same time that Cockcroft and Walton were developing the high-voltage method for accelerating particles, Prof. E. C. Lawrence of Berkeley, California, was experimenting with indirect methods which do not require large voltages. He was successful in developing the 'cyclotron', by means of which he accelerated particles to energies corresponding with nine million volts. The cyclotron has proved of immense utility to nuclear research. Unfortunately it is very expensive. The magnets of the cyclotrons at Liverpool and Cambridge weigh 50 tons each, of which seven tons is copper, and they produce a field of 19,000 gauss over a gap 90 cm. in diameter.

The new branches of physics are by far the most fundamental of any as they touch the ultimate constitution of matter itself. They can only be attacked successfully by very highly skilled teams of workers, as the number of pieces of intricate apparatus which has to function simultaneously is very large. New effects are being continually observed, and it is necessary to explain them and correlate them with existing knowledge.

Rutherford and Geiger were able to detect and count for the first time the number of α-particles emitted by a gram of radium, but the method has several defects and is exceedingly difficult to apply. The method now used is to amplify the current produced in a small ionization chamber by the pulse of ions due to each α-particle. This is heard as a loud click in a speaker attached to the amplifier.

Prof. Oliphant concluded by giving a quotation from Bacon, frequently used by Rutherford: "Human knowledge and human power are coextensive; for ignorance of causes prevents us from producing effects. Nature can only be ruled by being obeyed; for the causes which theory discovers give the rules which practice applies."

Radio Exhibition, Olympia

THE annual exhibition of wireless apparatus organized by the Radio Manufacturers' Association was held at Olympia on August 24 until September 3, and it was notable for such features as the replacement of the B.B.C. Radio Theatre by a glass-walled television studio in operation, the first large display of television receivers in actual operation on exhibitors' stands, and the complete demonstration of sound broadcasting receivers for the first time. On previous occasions the stands were supplied inside the exhibition with audio-frequency programme current, so that no demonstration of the radio frequency portion of receivers could be given. This year, arrangements were made for all stands to be supplied with radio frequency signals so that the various receivers could be demonstrated as a whole.

On the technical side, sound broadcasting receivers appear to have settled down to fairly standard types of design, and with the steady improvement of detail which has resulted in methods of lay-out and manufacture during recent years, the modern receiver is very efficient and supplies the needs of the majority of listeners. The chief novel feature among this year's sets is the incorporation of some form of automatic tuning, by means of which a certain number of broadcasting stations can be selected at will by operating switches on the front of the receiver. To what extent this feature was really required by the listener time will tell, but it would appear to be consistent with the demands of the age and to have advantages comparable with those of the automatic telephone and the pre-selector gear on motor-cars. The automatically tuned receiver is provided with a series of about six push-buttons in addition to the usual on-and-off switch; by pressing one of these buttons, the receiver is automatically adjusted to receive the programme from a certain station. In some cases the actual stations made available to the press-button control can be altered by carrying out certain more or less simple adjustments on the receiver. The manner of achieving this automatic tuning varies among the manufacturers and has called forth a considerable amount of mechanical ingenuity in some cases. The methods vary from the switching in of one of a series of fixed condensers across each tuned circuit of the receiver, to the use

of a motor driving the main ganged variable condenser in conjunction with an electrical method of obtaining accurate synchronism with the incoming signals. In all cases, the purchaser is assured that the addition of this automatic device in no way reduces the efficiency of the receiver as a whole or affects the ability to operate it manually.

On the television side, the large display of receivers in operation on the various stands demonstrated admirably that this phase of the art is now on a commercial production basis, and made the visitor prone to forget that the potential market at present is limited to those who reside within about thirty miles of Alexandra Palace. It is well known that reception of television has been successfully accomplished at much greater distances, but the above represents the reliable service range at present. A determined effort has been made by manufacturers to reduce the cost of television receivers to the minimum; and by the use of smaller cathode ray tubes, giving good results with a picture size of about 4½ in. by 4 in., complete sound and vision receivers are now available at from a little more than twenty pounds. At least one manufacturer has realized also that many listeners are already adequately provided with a normal sound broadcasting receiver, for there is now available a set for television reception only, but including the sound programme appropriate thereto. One of these sets gives a satisfactory picture of size 7½ in. by 6 in., and the price shows a saving of one third over that of a similar model giving all-wave broadcast reception in addition to the television. In many cases the previous version of the domestic television receiver giving a larger picture of size 10 in. by 8 in. has been retained, but it is naturally more expensive. Some firms provide more elaborate equipment which, by projection on to a small cinema screen, gives a picture of the order of 24 in. by 20 in. in size, and this provides comfortable viewing for a score or so of persons. In some cases this large picture is obtained by projection from a comparatively small image produced on the screen of a cathode ray tube of 3 in. or 4 in. diameter. In one case, however, the scanning was carried out mechanically by special forms of mirror drum, and the satisfactory demonstration given testified to the success which has been achieved in the development of the high- and low-speed motor-driven scanners employed in this system.

The remainder of the exhibition was devoted largely to the miscellaneous components and accessories utilized by the radio receiver industry. Loud-speakers and public-address equipment, test and service apparatus, special condensers, switches and other components were displayed in all their variety. The Post Office exhibit showed the various methods and devices adopted to mitigate the interference nuisance, and some firms displayed apparatus and devices for measuring and reducing this interference. Lastly, and by no means least, that most important component, the thermionic valve, was shown still to be making steady progress in the direction of increased efficiency in meeting the varied demands now made upon it. While it is perhaps regrettable that this development has resulted in an increase in the number of types of valves and also in the valve bases, some consolation is perhaps to be drawn from the fact that reductions in price of the order of 20 per cent on many types were announced by several manufacturers just prior to the opening of the exhibition. R. L. S.-R.

Science News a Century Ago

Ascent of Mont Blanc by a Lady

"A FRENCH lady named Dangeville ascended to the summit of Mont Blanc on the 4th inst. [September 1838]. She quitted the valley of Chamonix on the 3rd, at an early hour in the morning, slept at the Grand Mulets, and reached her perilous destination at 12 o'clock on the 4th. She remained on the summit of the mountain for about an hour, wrote some notes, and drank a health to the Count de Paris. The guides by whom she was accompanied spoke in the highest terms of her courage, perseverance and presence of mind. Previous to this successful trip, the feat had been accomplished by only one female, a peasant of Chamonix, who, on reaching the grand plateau became exhausted with fatigue and was carried by force to the summit. Mademoiselle Dangeville on her return to the Chamonix on the morning of the 5th inst, was received with the utmost enthusiasm by the inhabitants, who proceeded to meet her, and fired salutes of cannon in honour of her exploit." (Annual Register, 1838.)

Lyell at the Athenæum

WRITING on September 8, 1838, to Darwin, Lyell said: "I am very glad to hear you like the Athenæum. I used to make one mistake when first I went there. When anxious to push on with my book, after a 'two hours' spell', I went there by way of a lounge and instead of that, worked my head very hard, being excited by meeting with clever people, who would often talk to me, very much to my profit, on the very subject on which I was writing, or I fell in with a Review or Magazine relating to geology. Now this was all very well, but I used to forget that this ought to count for work, although nothing had been written, and that I ought consequently to give up my second 'two hours' spell. . . . As your eyes are strong, you can afford to read the light articles and newspaper gossip, which I could never indulge in much with impunity."

Colours of Thin Plates

THE *Mechanic's Magazine* of September 8, 1838, contained a contribution from Charles Tomlinson (1808–1897) on "Experiments and Observations on the Colours of Thin Plates". Prefacing his remarks by a note on the various modes of obtaining Newton's rings and the colours of thin plates which were generally known, he offered to scientific men some new facts. Some of his experiments had been made with spirit of turpentine and balsam of Peru. "When a drop of balsam of Peru," he wrote, "is allowed to fall upon the surface of water we instantly get a magnificent display of coloured rings: on applying vapour of ether, ammonia, etc., to any part of the film, its thickness is instantly reduced, so that the colour belonging to one order of Newton's rings is instantly exchanged for the colour of one of the series above it.

"A magnet seems also to have an action upon the film, the North pole tending to repel it, and the South pole to attract it."

Tomlinson, who was elected F.R.S. in 1872, made important discoveries concerning surface tension in liquids.

Societies and Academies

Paris

Academy of Sciences (**207**, 7–100, July 4, 1938).

H. DESLANDRES : Universal constant of band spectra. Attribution of the lines of the band to causes other than the rotation of the molecule. A simple relation is found between the frequencies of the molecule and the 'activated' electrons of its atoms.

R. FOSSE, R. DE LARAMBERGUE and J. GAIDDON : Synthesis of cyanamide by the action of silver oxide on formaldehyde and ammonia.

R. ESNAULT-PELTERIE : The output of [air-]screws.

P. FOURMARIER : The reciprocal relation between the discontinuities in the fold zone of Cornwall (England).

L. COUFFIGNAL : The operations of pure mathematics are all mechanical functions.

H. LAUGIER and MLLE. D. WEINBERG : Analysis of the spread [about a mean] of the total marks in the examination for the *baccalauréat*.

J. DIEUDONNÉ : Complete uniform spaces.

R. POTIER : Spaces with affine connexion and generalized Riemannian spaces.

L. I. GAMA : Additivity of the contingent.

A. BERMANT : Remark on Schwarz's lemma.

J. GALIBOURG and P. Laurent. Subpermanent deformations [of a body].

R. DUCHÊNE : New method for measuring gas supplies. The principle used is to inject a bubble of a foreign gas into the gas main and to ascertain the time it takes to reach a point at a known distance 'downstream'.

L. VIAUD : Study in a wind-tunnel of the aerodynamic characteristics of [wings fitted with] *dispositifs hypersustentateurs* placed near the ground.

G. BADARAU : Passage of corpuscles across spherical potential barriers.

A. VÉRONNET. : Mechanical determination of the constitution of atomic nuclei.

T. PECZALSKI : Statistical interpretation of the reactions between solids at high temperature.

R. MÉRIGOUX : Different structures of the mist deposited by blowing on certain [chemically] fatty substances.

P. TONGAS : Calculation of the gas constant for steam from the experimental results adopted by the International Conference of Steam Tables. The mean value for R is 47·062.

Y. LE GRAND : A logarithmic galvanometer.

V. P. MIHU : Absorption of energy by high-frequency currents in Geissler tubes.

T. V. IONESCU : New observations on ionized gas oscillators in a magnetic field.

S. GORODETZKY : An arrangement for improving the functioning of multiple coincidence detectors.

R. CHEVALLIER and MLLE. S. MATHIEU : Magnetic contribution of the constituents of iron hydroxide in an alkaline medium.

A. GUILLET : Control and measurement with the aid of images obtained by multiple reflections.

MME. A. VASSY and E. VASSY : Absorption of light by the lower atmosphere.

MME. J. GAVORET : Adsorption and swelling of α-cellulose.

E. MOLES and A. ESCRIBANO : Limiting density of the gases O_2 and CO_2. Atomic weight of carbon. The most probable value for the latter is given as 12·007.

MLLE. S. THÉVENET : Influence of electrolytes on the viscosity of an iron hydroxide sol.

P. CHEVENARD and A. PORTEVIN : New method for the study of metallic diffusion. The curve of magnetization against temperature gives a series of Curie points for the various concentrations and also gives extreme concentrations.

M. BACKÈS : Constitution of aldol and ethanal.

V. FROLOW : Analysis of the annual maximum of the Dnieper.

MLLE. Y. BOISSE DE BLACK : Glacial deposits of the basin of Condat (Cantal).

G. DÉJARDIN and R. BERNARD : The height of the layer in the atmosphere from which the D lines are emitted, and the origin of sodium atoms in this layer.

L. PLANTEFOL : Generality of extrinsic oxidations. Extrinsic oxidations appear to take an important part in gaseous exchanges, and can, under various physiological conditions, constitute an appreciable part of respiration.

M. SIMONET, R. CHOPINET and G. SOUILIJAERT : Obtaining a tetraploid *Linum usitatissimum* L. by the application of colchicine. The seeds were immersed in aqueous solutions of colchicine.

A. PEYRON and H. LIMOUSIN : The development, inside the veins in multiple *tumeurs à tissus* of the human testicle, of polyembryonic parthenogenic embryos.

MLLE. S. BELLUC, J. CHAUSSIN, H. LAUGIER and MME. T. RANSON : Variations in the elimination of the principal substances of [human] urine.

MME. A. DRILHON and R.-G. BUSNEL : Quantity and distribution of flavin in the Lepidoptera.

M. DELAVILLE : Effect of injections of morphine hydrochloride on the hepatic and cerebral lecithins of the guinea pig.

M. PIETTRE : Cold ultracentrifugation and the stabilization and sterilization of biological media.

C. CHAMPY and J.-P. LAVEDAN : Production of tumours by sustained regeneration in the testicles of birds.

Moscow

Academy of Sciences (*C.R.*, 19, No. 4 ; 1938).

A. ALEXANDROV : A general equation for closed plane surfaces.

N. LUSIN : Existence of algebraic surfaces without a continuous connected grid (3), (4).

J. KHURGIN : Upper limit of ion energy obtainable by means of the cyclotron.

L. V. GROŠEV and I. M. FRANK : Nuclear impulse in pair formation.

V. ČERNIAEV : Influence of noble gases on the intensity of the lines of the hydrogen and the deuterium Balmer series.

I. K. KIKOIN and S. V. GOOBAR : Gyromagnetic effect in superconductors.

I. D. BORNEMAN-STARINKEVITCH : Some isomorphic substitutions in apatite.

S. A. BOROVIK and S. K. KALININ : Spectroscopic analysis of the products of lead and zinc plants.

A. V. PEIVE : Carboniferous gypsums and the Devonian red sandstones of Tian-Shan.

L. LUNGERHAUSEN : (1) The terraces of the Dniester. (2) Pliocene hydrography of the South Ukraine.

A. F. FERSMAN : The number of mineral species.

L. A. KOSSOY: Intergrowth of quartz and feldspars from the pegmatite veins of Karelia.

R. A. MASING: Genetical and cytological analysis of lethals in *Drosophila* occurring in Nature.

L. N. KOKHANOVSKAYA: Physiological sterility in the cultivated Columbian potato, *Solanum rybinii* Juz. and Buk.

V. I. PATRUSHEV: Inheritance of biochemical characters in animals in connexion with growth. (3) On some indices of the blood composition of the hybrids between Bactrian camels and dromedaries in connexion with heterosis. (4) Differences in the composition of blood in horses, asses and mules.

G. S. ŽUKOVA: Influence of light upon the development of pollen of barley.

N. N. MEDVEDEV: Contributory effect of heat with irradiation in the production of mutations.

M. CH. CHAJLACHJAN and L. P. ŽDANOVA: Role of growth hormones in form-building processes. (3) Effect of hetero-auxin treatment of seeds upon growth and development of plants.

S. M. MASHTAKOV: Qualitative changes of rubber in the kok-saghyz roots in the course of plant development.

A. A. NICHIPOROVICH and V. N. BOUROVAYA: Rubber accumulation in kok-saghyz as a function of its biological process of maturation.

CH. S. KOSHTOYANZ: Mechanism of formation of the chemical mediators of nerve impulses.

Z. G. SČEDRINA: The distribution of Foraminifera in the Kara Sea.

J. RALL: Notes on the ecology of *Diplomesodon pulchellum pulchellum* Licht. in the Volga-Ural sandy regions.

N. L. GERBILSKY: (1) Effect of cranial injections of hypophysis suspensions in teleosteans. (2) The influence of the gonadotropic agent of the hypophysis on the spawning in *Acipenser stellatus*.

Tokyo

Imperial Academy (*Proc.*, **14**, No. 6, June 1938).

TATSUO KAWATA: A theorem concerning the non-vanishing of functions.

TOSIO KITAGAWA: Characterizations of the fundamental operations by means of the operational equations.

KÔSAKU YOSIDA: On the fundamental theorem of the tensor calculus.

SHIGEHIKO SUGASAWA and KICHIRO KAKEMI: Studies on the synthesis of dibenzopyridocoline derivatives (1). A synthesis of 5, 18, 9, 14-(2, 3, 11, 12-tetramethoxy)-dibenzo-6, 7, 15, 16-tetrahydropyridocoline.

HISASHI KUNO: (1) Hypersthene from Odawaramati, Japan. (2) The occurrence of a primary cummingtonitic hornblende in some dacites from Japan.

SYOZI IZIRI: On the embryonic tooth M_3 ($= m'_3$) and the os sacculi dentis of *Desmostylus japonicus*.

MASUZO UÉNO: Stratification of *Noctiluca* in a brackish water lake of Hokkaido, Japan.

YOSHITARÔ KATÔ: The relation of the anterior pituitary of the fowl to the production of the gonad-stimulating hormone. Castration causes an increase in the potency of the pituitary body. The basophilic cells are responsible for the production of the gonad-stimulating hormone.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

PRINCIPAL of the Sunderland Technical College—The Director of Education, Education Offices, 15 John Street, Sunderland (September 12).

JUNIOR SCIENTIFIC OFFICERS at the Road Research Laboratory, Harmondsworth, Middlesex—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (September 13. Quote ref. J./38/10.)

ASSISTANT (Grade III) in the External Ballistics Department of the Ordnance Committee, Woolwich—The Secretary, Ordnance Committee, Royal Arsenal, Woolwich, S.E.18 (September 16).

SCIENTIFIC OFFICERS in the Air Ministry Scientific Research Pool (radio communication problems)—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (September 16. Quote ref. No. 604/O).

JUNIOR SCIENTIFIC OFFICER (physicist) at the Fuel Research Station, East Greenwich—The Establishment Officer, D.S.I.R., 16 Old Queen Street, Westminster, S.W.1 (September 20. Quote *J* 38/11).

SUPERINTENDENT of the Marine Division of the Meteorological Office—The Under-Secretary of State (S.2.A.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (September 30).

EXAMINER (physicist) in the A.I.D. Test House, Kidbrooke, S.E.3—Under-Secretary of State, Air Ministry, Kingsway, London, W.C.2 (Quote ref. No. I.G.17).

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

British Museum (Natural History). John Murray Expedition, 1933-34. Scientific Reports, Vol. 5, No. 7: The Flabellid and Turbinolid Corals. By J. Stanley Gardiner and Peggy Waugh. Pp. 167-202+7 plates. (London: British Museum (Natural History).) 5*s*. [168

Strangeways Research Laboratory, Cambridge. Report for 1937. Pp. 23. (Cambridge: Strangeways Research Laboratory.) [178

Other Countries

Proceedings of the United States National Museum. Vol. 85, No. 3037: A New Genus and Two New Species of the Dipterous Family Phoridæ. By Charles T. Greene. Pp. 181-186. (Washington, D.C.: Government Printing Office.) [158

Division of Fish and Game of California: Bureau of Marine Fisheries. Fish Bulletin No. 51: The High Seas Tuna Fishery of California. By H. C. Godsil. Pp. 41. (Terminal Island, Calif.: California State Fisheries Laboratory.) Free. [158

Kungl. Svenska Vetenskapsakademiens Handlingar. Serien 3, Band 16, No. 5: The Alcyonarian Genus Bathyalcyon. By Sixten Bock. Pp. 54+2 plates. (Stockholm: Almquist and Wiksells Boktryckeri-A.-B.; London: H. K. Lewis and Co., Ltd.) [158

League of Nations: Child Welfare Information Centre. Summary of Annual Reports received from Governments between the Close of the First Session and the Close of the Second Session of the Advisory Committee on Social Questions (May 1st, 1937-May 5th, 1938). (Official No.: C.81.M.36.1938.IV.) Pp. 160. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 3*s*. [168

Nyasaland Protectorate. Annual Report of the Forestry Department for the Year ended 31st December 1937. Pp. 27. (Zomba: Government Printer.) 1*s*. [168

Rubber Research Institute of Malaya. Annual Report 1937. Pp. ii+211+2 plates. (Kuala Lumpur: Rubber Research Institute.) 1 dollar. [168

Colony and Protectorate of Kenya: Forest Department. Annual Report, 1937. Pp. 29. (Nairobi: Government Printer.) 1*s*. [168

Report of the Kodaikanal Observatory for the Year 1937. Pp. 4. (Delhi: Manager of Publications.) 3 annas; 4*d*. [168

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 42: Empirical Relationships between Count, Lea Strength and Staple Length of Indian Cottons. By V. Venkataraman and Dr. Nazir Ahmad. Pp. ii+16. (Bombay: Indian Central Cotton Committee.) 8 annas. [168

Hokkaidô Imperial University Calendar, 1937-1938. Pp. iii+227. (Sapporo: Hokkaidô Imperial University.) [168

Carnegie Institute of Washington. Catalogue of Publications. Pp. iv+146. (Washington, D.C.: Carnegie Institution.) [168

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 90. The Occurrence of Flints and Extinct Animals in Pluvial Deposits near Clovis, New Mexico. Part 6: Report on Field Season of 1937. By J. L. Cotter. Pp. 113-118. Part 7: Pleistocene Mollusks from the Clovis Gravel Pit and Vicinity. By William T. Clarke, Jr. Pp. 119-122. On the Relationship of the Nearctic Genus Dracotettix (Orthoptera: Acrididæ). By James A. G. Rehn. Pp. 123-132. (Philadelphia: Academy of Natural Sciences.) [178

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 30: Occupational Experiences for Handicapped Adolescents in Day Schools. By Elise H. Martens. Pp. iv+61. (Washington, D.C.: Government Printing Office.) 15 cents. [178